The
GEOGRAPHICAL JOURNAL

Vol LXXXVIII No 4 R.G.S. *October 1936*

PHOTOGRAPHIC SURVEYS IN THE MOUNT EVEREST REGION: *A paper read at the Afternoon Meeting of the Society on 11 May 1936, by*

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THE main purpose of Mr. Shipton's Expedition of 1935 (*Geogr. J.*, February 1936) was to see whether the conclusion of 1921, that the monsoon season was unsuitable for an attempt on Mount Everest, was applicable every year. When I was asked to undertake survey work as a member of the 1935 expedition I realized that conditions were likely to be adverse, since the Reconnaissance Expedition of 1921, while carrying out the important preliminary mapping of the region, experienced much bad weather and cloud. But it seemed that photographic methods of survey might be suitable, and it gave an opportunity to put the technique acquired in Greenland to a test of some severity.

From a surveyor's point of view things turned out by no means badly. Not only was Shipton an encouraging and gifted leader to the party, but he and his colleagues surprised me by throwing themselves actively into the business of assisting the survey. In particular he, Warren, and Kempson showed throughout the summer an unflagging interest in map-making which expressed itself in taking one of the instruments to stations on pinnacles and places that an untrained mountaineer would never have reached. Nothing can be more gratifying to a surveyor than such practical enthusiasm.

The dominant recollection of the summer is cloud. Nevertheless the weather was, I think, better than that of 1921. Wheeler must have had a very difficult time during his survey. He covered a large area and occupied high stations, resolutely climbing several times to the same point if necessary. One advantage he had over me: he was an experienced climber. But on the other hand I think I can reassure any prospective surveyor without this training by saying that even in the Himalaya effective stations can be reached by just walking; and that as far as 22,000 feet the normal person is not put to any severe endurance test.

The Mount Everest Committee were anxious to obtain a more detailed map of the north face of Mount Everest than that available: a more precise

knowledge of the heights on the route followed up the mountain would also be of value to the mountaineers of the 1936 expedition. This then was the principal task. Naturally we hoped to be able to add something *en route* to our rather slight knowledge of the country through which we were to pass.

The Wild photo-theodolite belonging to the Society and used by Major Mason in the Shaksgam in 1927 seemed in every way suitable for the Mount Everest part of the survey. But I felt that for rapid work in high territory something at once lighter and to me more familiar would be desirable. So I suggested that the Committee approach Professor Nørlund, Director of Denmark's Geodetic Institute, to see whether he might be willing to lend us the Zeiss photo-theodolite adapted for roll-film that I had used in Greenland in 1933. With great and, if one may be so bold as to say so, characteristic, generosity Professor Nørlund put the instrument and two tripods at our disposal, and in this way assisted the expedition very materially. All the work of assembling the equipment had to be done in three weeks, and I have reason to be grateful for the promptitude shown by certain firms such as Messrs. Agfa and Perutz, supplying film, and Messrs. Watts and Leitz (Leica), supplying instruments.

Mr. Hinks and I were agreed in considering the opportunity as one in which the broadest possible experience should be gained. So to the two sets of equipment already decided upon for photographic survey we added a third. The Watts-Leica photo-theodolite was to be the very extreme of portability and simplicity. The instrument as we took it into the field was a hastily constructed assembly of a Leica camera on a Watts Mountain Theodolite. It was intended for the Canadian or single-picture method of photogrammetry; but it was also an end in itself to find out to what extent this or any other technique of photogrammetry could suitably be recommended for people more skilled in climbing or travelling than in survey work. The value of a semi-calibrated camera to the explorer has not yet been fully worked out; here was a chance to make a start towards finding the usefulness of photographic methods to exploratory surveying. (Folding map at the end of the *Journal*.)

To glance over a few sheets of the Trans-Frontier $\frac{1}{4}$-inch survey is to realize how many opportunities there are for a surveyor in Tibet. At one time we had hoped to photograph the country to the west of and, for us, beyond the approaches to Mount Everest. The Lapche Kang range is only very approximately known and might have given some climbing experience to the party. But after talking it over we thought that it would be better, if we were to attempt any work away from Mount Everest, to use the fine weather before the monsoon broke. Since we expected to reach Rongbuk at about the time of the break of the monsoon, this meant that it would be best to photograph some district on the road between Sikkim and Everest. The Nyönno Ri range was the obvious point of interest.

After leaving Darjeeling on May 27 we crossed into Tibet on June 4, making for the junction village of Sar, which lies at the foot of the range we called the Nyönno Ri, after the Survey of India's designation of the highest peak, a 22,000-foot mountain. (This name, by the way, was unknown in the district. Nor was the name Sangkar Ri, for a conspicuous point on the same range a

Looking across the head of the Khartachangri Glacier. Points 20750 (left) and "Dent Blanche"(right)

Deglaciated country at the head of the Lang

little farther towards the north, familiar to the local inhabitants.[1]) Some of us who had been finding the continued climbing slightly distressing towards the end of the route out of Sikkim enjoyed walking over the level tracts of Tibet. The ritual of Asiatic travel was new and the weather fine. At nights it would freeze, but the mornings were clear, so that until about 10 o'clock the snow-range we were marching for stood challengingly before us. We were walking along the headwaters of the Arun river. A day's march from Sar a big stream from one of the glaciers in the Himalaya to the south crosses the route, turning the uncertain trickle that comes from farther eastwards into a decisive river. At Sar it swerves north to enflank the range before altering its course southwards into the valley above Kharta, after which it enters the well-known gorge cut through the Himalaya into Nepal.

There had been some delay in the issue of our passport from Lhasa, and we arrived at Sar without it. So in any case a halt was obligatory. We asked at once whether the authorities had any objection to our making a reconnaissance in the region. Finding no obstacles in our way we quickly got to work, urged by the patent inaccuracy of the existing map.

Impressions from the Sar work have been somewhat overwhelmed by the more vivid experiences in the Mount Everest region. Sar is at about 14,000 feet and the stations were at about 18,000 feet. The heights being moderate and the going easy, one could start some hours before dawn, picking a way across the marshes with a lantern and hoping for the sunrise as one kicked a way up the frozen scree-slopes. Between June 10 and June 20 I was able to occupy six stations. These I naïvely thought of as the beginning of a far-reaching survey to include the Nyönno Ri range and the territory to the east as far as Muk and to the south as far as the watershed. The work started by Shipton taking the plane-table, Kempson the Watts-Leica photo-theodolite, and I the Danish light equipment. Shipton found a pass through the range and made a beginning with fixing detail to the westward. Kempson's stations were on the range and commanded the country to the east. My stations were to map the range itself and then the main river valley as far as Lungme. Not until June 20 did it appear that we had unwittingly gone further than was pleasing to the higher authorities. By the next day it was clear to us, all parties being reassembled in camp at Sar, that the remaining photography we had hoped to do in the unknown western parts of the range could not be done. June 21 to 25, days of idle confinement in camp, were remarkably fine. The account of our work here would be incomplete without recording the generosity and hospitality of the Dzongpen of Sar.

The march from Sar to Rongbuk showed that the existing maps are very inadequate between Lungme and Tashidzom. When we arrived at Rongbuk on July 4 the wind was westerly and the whole country under cloud. This was responsible for giving us a very imposing first sight of Mount Everest. As we walked up through what Norton called the "gates of altitude" a slight clearing in the cloud revealed the mountain—but not where we had looked for it. The peak was just about twice as high above the horizon as expected, and the bulk of the mountain appeared enormous. The ridge to the summit seemed utterly remote and inaccessible.

[1] It is Mr. Odell's opinion that this range should be called the Gyangkar Ri.

Deglaciated country at the head of the Lang

The Rongbuk valley itself produced something equally fantastic. The numerous chortens, cairns and *mani* walls made one conscious of treading on sacred territory. But when suddenly the barren valley contained a crowd of some two hundred persons, inhabitants of the monastery, one wondered where one had strayed.

That night there was a great thunder and hail storm and in the morning the wind was in the east. July 5, 6, and 7 were days of dazzlingly fine weather, when Mount Everest and all the high peaks, white with new snow, were clear and glittering the whole day through. Unavoidably a certain amount of time had to be spent in unpacking and rearranging stores, as well as in observing the customary formalities at the monastery. We had arrived just at the end of one of the occasions of pilgrimage. Among those who had come to Rongbuk was a friend of former expeditions, known as Old Father William, a wealthy Tibetan from the Kharta valley. There was a very great crowd of people at the monastery and on the last evening they played some fine concerted music.

My own plans had meanwhile developed to become an attempt to make a survey bounded to the west by the western heights of the Rongbuk valley, to the north by Base Camp, and to the south by Mount Everest: the eastward limit was left indefined.

The decision to re-survey in part a region already surveyed did not imply that the existing map was in any way inadequate. On the contrary, Wheeler's 1-inch map covers a very large area and without it as basis I doubt whether the present photogrammetric survey would have been possible.

I began by taking stations on each hand of the Rongbuk valley at the Base Camp. Fording the glacier stream before dawn to reach the western station was possible but exceedingly unpleasant. I then went up the side valley to the east of Base Camp and managed to get two stations in the basin north of the triangulated peak 23180 (Kellas Rock Peak). After summoning more provisions from Rongbuk I started up the western side of the Rongbuk glacier, with the idea of pushing up towards the Lho La, but decided that it was the wrong side from which to descend on to the glacier, which in any case was a very unfamiliar kind of glacier to me. So, after getting a station on a height opposite Camp I, I started off to join Shipton and the rest of the party at Camp III. My party met some of the Sherpas of the climbing parties at Camp II. We were told dreadful stories of the necessity of going through raging glacier torrents waist deep in which somebody had nearly been drowned the day before. But next day we got to the "trough" up the centre of the East Rongbuk Glacier without any trouble and there met Shipton, Kempson, and Wigram descending.

There followed some change of plans. For the rest of the season I was privileged to be with one or other climbing party, on the two journeys up the Khartachangri Glacier and the final tour to Kharta. The sequence of events is described in Shipton's paper (*Geogr. J.*, February 1936).

Generally speaking I worked as described in the paper by Professor Nørlund and myself ("Some Methods and Procedure developed during recent Expeditionary Surveys in South-East Greenland," *Geogr. J.*, October 1935). But bases are much more difficult to obtain in the Himalaya than in Greenland. In particular it is difficult to find a base commanding Mount Everest.

One's problems are much confounded by the bad weather and the natural reluctance to climb induced by the altitude. Even if one knows of a possible base it is difficult to decide how many days one is prepared to invest in its doubtful success. The climber, forced to make his peak in a snowstorm and fog, considers his achievement a partial success and moves on to the next task. But a surveyor requires much more of the weather: the longer he spends getting to his station, the less likely he is to get the weather he requires.

As July passed and led into August, extreme speed of working became necessary: often I had to have all the observations from a station finished by 7 a.m. I used to attempt to get into position at the station by 5 a.m. and from then would wait until the dawn brought enough light to illuminate the theodolite circles. This meant abandoning most of the desirable features of triangulation routine. A second round of angles was quite out of court. The collimation constant of the level, which has to be known for the Wild instrument, could only be determined about once every four stations. Very careful choice had to be made of the points to which observations were made, if the station was to be finished. These rushed stations were very tiring, as much or more than a whole day's travelling.

My Sherpa assistants were excellent. In particular Tewang and Ang Tsering deserve mention. The latter was new to responsibility, but showed himself in the course of the summer to be reliable and sensible and to have a natural gift of leadership. Tewang is better known as a trustworthy and intelligent person—he can in fact write; but he is beginning to be rather too old for load-carrying at high altitudes. This summer he struggled on handicapped by amoebic dysentery: he must have had a good deal of distress, but only went back to Kalimpong for treatment after I had been frightened by the appearance of similar symptoms in myself.

On September 6 we finished as much as we were able to do for the photogrammetry of the Mount Everest region, and returned via Kharta, regretfully abandoning the completion of our photography in the Nyönno Ri Mountains in obedience to the wishes of the local authorities, who had received definite instructions on the subject from Tenkye Dzong. We had some ten days to spare, and it then occurred to me to make use of the remaining survey material in a short campaign in the extreme north of Sikkim. We had noticed on the way out that those fine peaks and ranges near and on the Tibetan border were very inadequately mapped. So I thought of spending a week in the valley which runs parallel to the frontier north of Kangchenjhau (Kangchima) and Pauhunri. The base would have been at the station Gayokang. But when we arrived there a variety of circumstances such as the parlous state of our equipment and the obvious persistence of the monsoon, together with the consideration that I had work at home more urgent than a survey having nothing to do with Mount Everest, persuaded me to give up the project and push on to Bombay with all speed.

It was possible to make a few physiographical observations on the journeys in Tibet. For instance it is obvious before one comes to Sar that the wide flat-bottomed valley of the Yaru Chu is a lake bed. My untrained eye was not able to trace evidence for more than one lake terrace above the gorge at Rongkong. In the neighbourhood of Tshetok there is still extensive flooding

of the valley floor. The lakes contain much pond-life, weeds and crustacea, which one would have liked to investigate. There are trout in the rivers and channels all up this valley. But most surprising of all is the number of common terns—animals one had previously thought of as sea-birds. There were many birds here which Kempson attempted to observe and will perhaps at some time give an account of. The Tibetan goose is one of the most striking of them.

Beyond Rongkong the river has cut itself a gorge, which is now working back through the lake deposits. The river is there called the Yaru Tsangpo and again runs over a lake bed, though here the terracing is more complex and much higher above the valley floor. The structure of the river already observed is typical. A lake basin is followed by a gorge which now cuts back into the basin preceding it. The Kharkung gorge extends really from the head of the Kharta basin to the villages round about Ne. The present stream has cut deeply into the water-laid strata, apparently revealing alternating periods of drought and raininess. Terracing is again obvious in the valley of the Phung-Chu above the Kharta district.

The filled-up lake floors, the rubble-filled narrow valleys seen between Lungme and Tashidzom, and the type of erosion in the Sar district all point to a period or periods of great rainfall rather than an extension of the existing glaciation. Auden, of the Geological Survey of India, has told me of similar pluvial evidence on the southern slopes of the Himalaya.

The Arun river itself is distinguished by its gorge through the Himalaya. It is generally assumed that as the folding of the Himalayan range took place the gap maintained itself. But there is a striking point in connection with the glaciation of the region. To cross from the Rongbuk region to a side valley of the Arun is equivalent to passing from East to West Greenland. The two districts are in completely different stages of glaciation. But the maximal glaciation would appear to have been the same on both sides. The present retreat of the glaciation in the Kharta valley is due to the masses of warm air coming up the Arun valley. As explained in Appendix IV, the cold north-west wind holds at even moderate heights during most of the monsoon period. Often, when the weather in Rongbuk was fine and cold, the Kharta district could be covered in a dense ceiling of cloud, under which, presumably, rain would be falling. These facts might be taken to indicate a more recent origin of the gorge.

From the photographs taken with the two photo-theodolites and earlier material the network of the Everest and adjoining survey is now plotted and heights have been calculated in the Everest region. Plotting has been by graphical methods; none other would have been possible. The rays were laid out on Kodatrace and the sheets from several stations superimposed where doubts or discrepancies arose. The state of affairs seems to be somewhat as follows. Wheeler started with a number of points supplied by the Survey of India. Morshead attempted to check the accuracy of these points by observations from a station north of the range, but he was impeded by cloud from getting any results. Wheeler found that some of the points given were non-existent, or grossly in error. Others were somewhat in error—for these Wheeler was able to determine better positions by use of the remainder. But even the remainder were probably slightly in error and any attempt to survey into the

View from above Sar eastwards up the valley of the Yaru Chu

compromised network reveals the shakiness of the whole system. The principal effect is to make it seem that certain individual points are erroneous, partly due to an accumulation of slight error from other points. Actually the adjustment in plan can be made so that the distortion is very slight indeed. But where the observations to peaks are at such considerable angles of elevation it is difficult to make a height network of great accuracy, or even sufficient accuracy for photogrammetric purposes.

As previously stated, the long-base range-finding method was used. Its value for reconnaissance was very strongly shown during the journey to Kharta. Here, as on so many other reconnaissance surveys, it was necessary to travel as fast as possible. As travel meant crossing at least one pass every day, one tended to lose sight of one's fixed points. After crossing the last pass into the Lang Chu we were in very foreign territory. Three stations were planned and occupied in two mornings, Dr. Warren taking one of them with the Watts-Leica instrument. It was by no means easy to fit these stations together or into the network. There were in fact several possible solutions. But by using the approximate length of the rays along which distances had been measured in Station XXV a criterion for the final solution was obtained. Thus the actual lengths were not used; but the fact that they must be approximately correct was decisive.

For a surveyor interested in the development of the technique of exploratory and reconnaissance survey it was a productive summer. I found that travellers of Shipton's calibre became with greater experience more and more anxious to make maps; I feel that it is a proper occupation for experts to turn this enthusiasm to good purpose and devise methods of survey whose field operations can be carried out by climbers and people with non-technical minds. Photographic methods are not only adaptable to this end, but were taken up with understanding by the members of the 1935 party. In fact they asked to be initiated into the methods of stereo-photogrammetry, seeing its value in the survey of a region often obscured by fog, when the grasp of the topography and recognition of points necessary for plane-tabling become very difficult. The impression, strengthened by such abortive attempts to use the R.G.S. equipment as that of the Oxford University Club's expedition to Spitsbergen, that the photogrammetric method is not suited to exploratory surveys is erroneous: the criticism contained in the appendix to Mr. Glen's account ('Young Men in the Arctic,' Faber & Faber, 1935) is that of an uninstructed person.

As I see it, the crux of the problem of photographic survey is provision for the working out of results afterwards. Certainly intrinsically better and greater results can be obtained by the use of photogrammetric methods in the field; but something like a permanent establishment is required to plot the work afterwards, equally whether mechanical or simple methods are used. I suspect that in such an institution as Professor Finsterwalder's in Hanover those learning survey can help in the plotting of expedition results. No doubt the Royal Geographical Society will see to it that a Mount Everest survey is plotted. But one hesitates to advise other expeditions to use photographic survey as long as there is a risk that there may be no opportunity of getting the results worked out.

ourney to the Lang Chu: looking orthwards on to the Tibetan plain

APPENDIX I: THE SOCIETY'S WILD PHOTO-THEODOLITE IN THE FIELD

In its original form the Wild outfit is portentously bulky and heavy for exploratory work. A beginning was made towards lightening the assembly by replacing the old tubular subtense-bar by the new invar bar from the same firm. Lighter tripods have also appeared since 1927; they weigh 10 lb. complete. In the field weight was cut down by leaving at the Base the long-focus camera, used only on special occasions. (That the camera was afterwards stolen from the dump was an unfortunate, but not a necessary, consequence.) Nor was this the final weight-saving. The equipment includes a heavy box containing three pairs of base-rings and sighting targets. It became my custom to take two rings and one target in my rucksack, leaving the rest below. When the station to be occupied has been especially difficult I have taken the plate slides wrapped in clothing in my rucksack and left their case (of metal) behind.

But even without this last expedient the total load was cut down from nearly 250 lb. to something nearer 130 lb., if only a dozen plates and two tripods are taken into the field. This can be distributed as three very moderate loads for mountain work or two full loads for valley transport. The remaining accessories, note-books, binoculars, etc., must be carried by the surveyor himself.

There is still a possibility of saving weight on the subtense bar, weighing at present 14 lb., by using a type that I have seen in experimental application in Denmark, where a couple of targets slip on to the ends of an aluminium rod, divisible like a tent-pole and held in a light aluminium casting. All weights in exploratory survey must be measured against the 2 lb. which is the weight of a man's daily food ration.

APPENDIX II: LUBRICATION

A minor point arising out of the use of both the Wild instruments, the Society's photo-theodolite as well as the Survey of India's Universal theodolite, was the defective lubrication. Both instruments became unreasonably difficult to handle at very moderately low temperatures, *e.g.* at no more than 10 degrees of frost. If however the instruments had been all night in the field—frequently during a high traverse I would visit the station on the previous evening and leave the gear up there—exposed to such temperatures as 20 degrees of frost, then foot-screws, slow-motions, focussing-ring, etc., were all locked fast and only to be shifted by the use of considerable force. It was the grease or vaseline with which the various bearings are packed which was at fault. In one or two instances the oil supplied accessory to the instruments was used to replace the grease; it seemed to be perfectly satisfactory at low temperatures. The grease has not only the disadvantage of arresting the motion of the bearings at low temperatures, but it also begins to run at moderate degrees of warmth, so that the handling of the instrument becomes a function of temperature.

APPENDIX III: TRANSPORT

The approach to Mount Everest is over a path passable to mules, donkeys, and yaks. Which of these animals one gets is generally settled by local conditions. The mules are fastest and in good condition can do the average 25 miles of a double stage in a day. Donkeys are not so fast; when they are in good condition a double stage is not beyond their powers, but successive double stages cannot be covered without distressing the animals.

Yaks are strong and reliable, but so slow that there can be no question of double marching.

Each of these methods of transport is very rough on the loads. The best loads would be packed in boxes and would weigh about 60 lb. When Major Mason was in the Karakoram in 1927 he packed the loads in a layer of spongy rubber; the wisdom of this arrangement was well shown during this year's expedition. My own ignorance of conditions led to some avoidable wear and tear. The "Venesta" boxes are to be recommended, especially for stationery and minutiae. Rucksacks were not good; not only the contents, but usually also the rucksack itself became broken. This style of packing also offers too much temptation to mule-drivers to search and to rob.

It might have been thought that boxes were an awkward form of packing in very mountainous country. But this is not the case. A Mount Everest porter makes up such a load with his own property into a cumbrous parcel which he carries by means of a head band. It is convenient if loads can be broken down into smaller units than the above-mentioned 60 lb., though 60 lb. is a load which could be carried by a porter on a main transport line between camps.

APPENDIX IV: WEATHER

The main periods of the weather were defined first by the approach of the monsoon and then by its weakening. The front of the monsoon is not a definite thing; it is rather a zone in which disturbances from the main monsoon advance and retire and traverse. In Mount Everest literature the "break" of the monsoon is a term usually employed to mean the instant of arrival of the first of these skirmishing disturbances. From that time onwards, of course, similar disturbances are likely to come up from the plains, bringing snow and cloud. But it may be some time later that the great body of warm air reaches the highest Himalaya. And there may be a longish period of fine weather between the first storm and the arrival of the deep mass of monsoonal air.

We crossed the frontier into Tibet on June 4 and did not reach the Mount Everest region until the first days of July. Our observations are therefore taken at different times in different places. When we entered Tibet however we found a definite routine obtaining which we took to be typical of pre-monsoonal conditions for that territory. We had the Sar district under observation from June 4 until June 26, since the Nyönno Ri can be seen from the Kongra La. The mornings were fine and clear until about 9 a.m., when cumulus clouds would form round the mountains; at about 10 a.m. a south-west wind would begin to come in, soon hardening to a fresh breeze and itself strong enough to forbid instrumental work, even if the clouds had allowed it. Such conditions were however very nearly ideal for survey. The nights were cool—at 15,000 feet in the valleys there were a few degrees of frost on most nights. But even at 18,000 feet the cold was not severe. Work was possible from 5.30 a.m. onwards and to finish a station before 9.30 presents few difficulties. The form of the hills made the choice of bases easy; probably the whole district could have been surveyed without recourse to bases laid out on snow.

It is not suggested that every day was of precisely the type described. There were of course alterations superposed on this régime. But it was not until June 26 that this rhythm seemed definitely to be broken. What actually happened was that it began to rain at night and on into the morning. The days were continuously clouded. In that part of the world, some hundred miles eastward of Mount Everest, the upper, rain-bearing wind seemed to be easterly

or north-easterly, although often the day wind from south-west or west would blow underneath it. Both the valleys flanking the Nyönno Ri, the valleys at Sar and at Kharta are noted for the strength of their local winds. Curiously enough we found even during the pre-monsoonal period that as low as 2000 or 3000 feet above the valley floor these winds were very much weaker.

The weather about Mount Everest between the fine period at our arrival and the beginning of August was irregular but seemed to overlie a rhythm, occasionally concealed, of the same type as the weather of Sar. Interspaced between days which started fine and clouded up fairly early there were single days of bad weather. The worst day was July 16, when snow fell until well below 16,000 feet. This day found Shipton and his party on the North Col, where the great mass of snow made movement dangerous and rather falsified the impression of conditions there. But in general the bad days came singly, not as in the Alps in groups.

During the first part of August these bad days increased in frequency until the peak of the monsoon period. The worst week began on August 9 and was, as we found later, caused by a depression passing along the foothills of the Himalaya. The wind began in the north-easterly quadrant and snowfall was fairly continuous, though there was a tendency to clear in the forenoon. The temperatures were high even at considerable heights and the daily range very small. At that time, I was told later in Calcutta, the warm monsoon air extended to a height of 20,000 feet above the plains of India. The party attempting the North Peak encountered temperatures little below freezing point at night at a height of 23,000 feet. It was hardly surprising that snow conditions were so bad.

Towards the end of this period the wind veered round to the west. As early as August 18 I find entered in my diary the query: "Is the north-west wind beginning to blow over the top of the monsoon?" During the bad weather period survey work had been much impeded, and it had been only possible to snatch a few subsidiary stations.

Thenceforward the weather improved continuously and it was plain that the cold, dry north-west wind was becoming dominant. The nights became colder; temperatures down to 10° F. prevailed at night at 20,000 feet and the daily range increased again. The old routine of clear mornings became re-established in the Rongbuk region and steadily spread its influence eastwards. It became possible to work major stations again, though they were actually beginning to be difficult to carry out on account of the low morning temperatures, the later sunrise, the early and sudden formation of cloud and the fact that we were often working on snow.

When we returned to Sikkim in mid-September we were somewhat surprised to find the Bay of Bengal monsoon still vigorous. Mr. Sen, of the Calcutta Meteorological Office, was kind enough to give us an interpretation of this and the other features of the 1935 summer in India.

It had, he stated, been an exceptional summer. The monsoons both in the Arabian Sea and in the Bay of Bengal had been late in starting. Nevertheless the total rainfall in Burma, Assam, and Sikkim were above the normal. On our way back to Gangtok we ourselves witnessed spoilt crops, soil washed away, landslides, damage to roads and destruction of bridges—all the features of excessive rainfall. On the other hand, Calcutta and Lower Bengal were markedly short of rain. These varied phenomena can be linked up by showing them to be caused by the exceptional strength of the westerly Himalayan wind-current, which, persisting throughout the summer, diverted the whole body of the Bay monsoon away towards the east. For the Mount Everest district this meant a weakening of the Bay monsoon to almost negligible proportions. The greater

Ama Drime in the "Nyönno Ri" range: Sar in the right middle distance

From a pass on the route to the Lang Chu: showing points 20750, Lhotse, Everest, and

part of the precipitation in that district is normally caused by the Bay monsoon. Actually the two branches of the monsoon, that from the Arabian Sea and that from the Bay of Bengal, meet in the neighbourhood of Mount Everest. The persistence of the north-west wind this year prevented, at all events in July, anything but occasional carry-overs from the Arabian Sea reaching our district. The August period was more normal; the presence of the depression south of the Himalaya induced monsoon air into the region. But as soon as that depression moved eastwards and filled in the north-west wind re-established itself and brought fine weather.

APPENDIX V: PHOTOGRAPHY

In the Wild camera the so-called Topographic emulsion made by the Ilford firm was used on plate-glass plates. The material was developed in England after the plates had passed twice through the tropics. On development the plates were found to be in no way fogged; the images were bright and excellent. There were however disfiguring marks all over the plates in the form of patches of deposited silver. These deposits occurred where the surface of the emulsion had been rubbed against the surface of the plate packed opposite, during the long, jogging ride on yak or mule-back. The marks were visible before the development of the plates. Had the plates been repacked with separating strips of cardboard (as they are packed by the makers) no doubt this annoying trouble would not have occurred. I have never heard of a similar case of this source of damage. However it is not expected that the plates will be any less valuable for survey purposes from this cause.

The film material was the same as that taken to Greenland in 1933. It was the well-known Perutz "Topo" emulsion on thick air survey film. On development (again after return) we were spared the disappointment of finding disfiguring marks. In fact most of the illustrations for this paper are from this survey camera. But there was a certain loss of brightness of the images, as though there had been consistent slight under-exposure. Something of the same sort happened to the film kept for a long time after the Greenland season, especially where the film had been kept in considerable warmth. After talking to Messrs. Kodak about these phenomena I realize that exposure should be deliberately made very liberal if there is a likelihood of delay before development.

The electric exposure meter by Weston was invaluable for all classes of photography and showed itself capable of standing up well to the severe conditions of a Mount Everest expedition.

APPENDIX VI: NOTE ON THE MAP

The map published with this paper has been drawn by Mr. Milne with the help of all available photographs. No really satisfactory base was obtained commanding Mount Everest; the lie of the country and the outstanding height of the mountain make it a curiously difficult subject for terrestrial photogrammetry. From the floor of the valley at Rongbuk the mountain is seen at a better angle than from the 24,000 ft. summit of the North Peak. Yet no convenient position for a long base was found at a great distance; in contrast the survey of Makalu, for instance, would be straightforward. Closer to Mount Everest all the accidents of the terrain work against finding a base. In consequence neither of the stereogrammetric stations VIII or XI gave really good contours. However, the contours obtained have been the basis of the present map; they have been checked and improved by a multitude of spot-

the Lang Chu: showing points 20750, Lhotse, Everest, and

heights obtained by intersections from the photographs at these two stations, occasionally amplified by rays from Col. Wheeler's photographs of 1921. Prof. Nørlund kindly allowed me to plot one pair of plates at the Geodetic Institute in Copenhagen; the second pair, taken with the Wild instrument, were kindly plotted for us by Messrs. Wild at Heerbrugg. The rock drawing is taken from the diversity of pictures accumulated during the course of the various Mount Everest expeditions, and the position of the detail was fixed in relation to the spot-heights. The map is, then, a fully responsible photogrammetric survey.

DISCUSSION

Before the paper the PRESIDENT (Major-General Sir PERCY COX) said: Mr. Michael Spender has been well known to us as a surveyor since he took part in the Great Barrier Reef expedition. On his return in 1929 he devoted himself to the study of photogrammetric survey, spending more than a year under Professor Baeschlin at Zurich and in the field with the Swiss Federal Surveys. He then went to study in Germany. Following that he has spent two or three years with the Danes, first with one of Knud Rasmussen's expeditions, and later in the service of the Danish Geodetic Institute on the East Coast of Greenland. With this wide experience of the several methods in use on the continent of Europe he probably knows as much as any living man of this intricate subject of stereogrammetric survey. His latest task was, as a member of the Mount Everest Reconnaissance Expedition of 1935, under Mr. Eric Shipton, to make the first accurate survey of the northern face of the mountain, and to introduce the climbers in training to the charms of photographic survey, with the excellent results which he will now describe.

Mr. Spender then read the paper printed above, and a discussion followed.

The PRESIDENT: I will ask Professor Mason to speak, if he will be so good. He knows the Himalaya exceedingly well and has done much good surveying there.

Professor MASON: There are one or two points I should like to stress in the extremely interesting paper submitted by Mr. Spender. Towards the end of the paper he says that the impression "that the photogrammetric method is not suited to exploratory surveys is erroneous: the criticism contained in the appendix" to a recent book "is that of an uninstructed person." I think it must be obvious to everybody that if it is possible to get an accurate map by this method at a station in twenty minutes of fine weather, an accurate map, for instance, of the north face of Everest, there are some points, anyhow, about the method. We have been waiting for the map of the north face of Everest ever since 1921. Now we have it, thanks to Mr. Spender and twenty minutes of fine weather.

As to the question of "uninstructed persons," we have no means in this country of properly instructing persons—Mr. Spender himself was instructed abroad—and I think that is a great pity. It is now nearly thirty years since this country took the lead in this method. In 1907 Vivian Thompson designed an instrument and plotted a map of the Lake District from stereoscopic pairs of photographs. He was told that the map was too much like the Ordnance Survey Map and that he must have taken a little help from that Survey.

In 1913, when we in India produced a map of the Taghdumbash Pamir, we were told that it was very nice, but that there was no map to check it by. Since then we have lost the lead. Both instruments and methods have improved vastly, and yet we are still in that extraordinarily conservative habit in this

country of saying "what was good enough for our grandfathers is good enough for us." It is not! You cannot in these days have a map that is too accurate. Geographers, geologists and geomorphologists—in fact every "geo-body"—want accurate maps. It is impossible to do scientific work properly on the old class of maps. We want to know much more about Everest, and once we get good maps we shall be able to learn more about it. The recent maps produced by Finsterwalder and others abroad are amazingly accurate and extraordinarily good. It is surprising what can be learnt from a close study of those maps. This is the first real chance we have had of doing this type of work.

The question of plotting now comes in. Mr. Spender says in his paper that he is chary about recommending this method of stereo-photographic survey to explorers from this country unless there is some probability of having the maps properly plotted afterwards. Well at present one is rather inclined to agree. We do this work now in India, yet we have to send our photographs to Switzerland to be plotted. Now this method is eminently suited to secret and confidential surveys: and in India some of our maps have to be confidential. Are we to compile these maps from material sent to Switzerland to be plotted? It seems to me that that is all wrong.

Many countries in Europe now have three or four of the instruments in constant use. We are told that this country cannot afford one. Portugal has one. There are many countries no bigger than Portugal who have them. What is the remedy? This Society cannot afford one off its own bat. Perhaps the Government of this country, which has already spent the cost of perhaps three in experimenting from first principles, might deign to buy one already made abroad! I do not know.

Then there is another difficulty. You must have trained engineers to plot these records. We are told that there is nobody in this country capable of doing it. I cannot believe that we cannot produce them. I refuse to believe it.

One last point, the question of spongy rubber as used for purposes of transport. I recommend you to read carefully the appendices in Mr. Spender's paper. They are extremely interesting. He suggests that I was a wise man when I thought of spongy rubber for protection of my instruments. It was not my idea. That, again, was one of the very many useful pieces of advice I had before I set out on my expedition from Mr. Hinks, who knows as much about this method as any man in this country, and as much as most in any other country. I can see no reason why, in addition to his many other duties, he should not find time to instruct three or four people in the use of this instrument when the country buys it!

The PRESIDENT: Mr. Thompson is a member of the Geographical Staff of the War Office. I am sure he has some useful comment to make.

Mr. THOMPSON: I am afraid I have not very much to say on the technical side, because I have had absolutely no experience of this type of mapping, all my experience being with mapping from air-photographs. I should however like to congratulate Mr. Spender on a most excellent piece of work. From what I have read of the method, the difficulty of choosing stations in ordinary country is bad enough, but in such excessively mountainous areas it must have exercised all his ingenuity. From the point of view of the usefulness of the method, I was recently over in France, and I was told by the Service Géographique de l'Armée that when they have two methods to choose from, the making of maps from air-photographs or from ground-photographs, they find that in hilly country, provided they do not get more than about 20 to 30 per cent. of dead ground in the terrestrial photographs, it is much more economical to use them. Their method in the Alps was to map the sides of the valleys with ground-photographs

and then fill in the dead ground, usually at the bottom of the valleys, with air-photographs flown up the valleys.

The other part of Mr. Spender's paper which interested me very much was that which referred to the use of the Leica camera. It would be interesting to know the kind of accuracy he was able to obtain with it. I would also like to ask what percentage of photographs were plotted in the Wild machine and what photographs have been plotted by other methods.

Mr. SPENDER: We have so far only had a couple of pairs of photographs plotted in plotting machines, one pair in Copenhagen and the other in Heerbrugg. That is all the work that has been done on the photographs. At the moment the survey is, so to speak, in abeyance.

We did not use infra-red photography in the Mount Everest region because, for the most part, the shots were comparatively short. In my experience infra-red photography is not worth considering unless you are photographing over a distance of at least 50 kilometres. Beyond that distance the infra-red method is most helpful; otherwise it renders photography more difficult. In the Mount Everest region we were of course up against much cloud, which could not be overcome by the use of infra-red photography. As for the air-photographs, they will no doubt be very useful when we come to putting together a map of the summit of Mount Everest itself. So far the map has not reached a stage in which the air-photographs have been called upon.

The PRESIDENT: If no other member of the audience wishes to make some observations I will ask Mr. Hinks to say a word or two before we conclude. You have heard the tribute paid by Professor Mason to his great knowledge of these abstruse questions, the photo-grammetric and the stereo-photogrammetric methods. Indeed, in regard to all matters of survey he is a great expert. I will ask you to excuse me now as I have an urgent appointment to keep. I will leave the winding up of the discussion to Mr. Hinks.

Mr. HINKS: I am indebted to the President for giving me the opportunity of speaking of the spasmodic interest which I have been able to take in the question of survey by photography, especially survey by the stereo-photogrammetric method. It was in 1924 that, having gone upon a mission for the Mount Everest Committee to Switzerland to arrange with M. Jacot-Guillarmod to come to London and to draw the map published in the Mount Everest book of 1924 and repeated in the book of 1933, I took the opportunity of going to see Heinrich Wild and the instruments which he had constructed at that time for stereo-photogrammetric survey. As a result of that visit, when Major Mason, as he was then, was planning the Shaksgam Expedition and inquired what the Society would do to help, it was soon arranged that the Society should buy a Wild Photo-theodolite and send it out for his use in the Shaksgam. It will be within the recollection of many present how extremely well Major Mason carried out those surveys and what very beautiful maps were produced of hitherto almost unmapped country.

Major Mason plotted the plates at Dr. Helbling's Vermessungs-Büro at Flums. We hoped that this experiment would stimulate more interest in this question in England, and that long before now we should have some means, perhaps connected with this Society, of being able to plot any pairs of photographs taken on one of the stereographic survey cameras. Indeed, in 1929, when the plans for the new part of our building were made, there was a certain room on the basement floor which was, at any rate in one's mind if not officially on the plans, intended as the place where one day there might be a stereographic plotting machine. But things do not move very rapidly in the way of converting people in England to this method.

Therefore I was exceedingly glad when Mr. Spender, on his return from the Great Barrier Reef, proposed to devote some years of his life to the study of these methods. How thoroughly he has done so the President has already described.

The question now comes: How is this knowledge going to be utilized to the best advantage? Here we are in 1936 apparently no nearer than in 1926, when Major Mason was in the Shaksgam, to having a stereoscopic plotting machine for use in this country. Mr. Spender has recorded in his paper that of the two pairs of photographs made on each of the photo-theodolites on which his map was based, one pair had to be sent to Heerbrugg to be plotted, and the other pair was taken to Copenhagen to be plotted by the kind permission of my friend Professor Nørlund.

That was all very well in 1927, but it is not at all satisfactory in 1936.

I feel that there is plenty of scope in this Society for an official whose duty it should be to establish here a more or less experimental but definite plotting department, that could make the best use of the photographs that will be continually pouring in in different ways, some badly taken, but some very much better taken if there is knowledge that they can be properly plotted. There is the mass of material mapped by the Mount Everest Expedition in 1935, and they will have mapped a great deal more in 1936. Those who took pictures in 1936 will want to be able to plot them. We want an officer on the Society's staff, aided by a draughtsman, who can deal with material like that.

A question was asked: What is going to be done with the Mount Everest Flight photographs? Mr. Spender partly answered that question. We have made here during the last year a sort of map of the southern face of the mountain from the Flight photographs, which is complete as regards horizontal detail but has no heights as yet. We are hoping that the work Mr. Spender has done will enable us to obtain approximate contours of that; and so by our method of fitting in one thing with another we shall eventually have, thanks to Mr. Spender's work, a reasonable map of both sides of the mountain.

I mention all these things only to show that if some one could find a way to provide the Society with the means for establishing a plotting machine, and to obtain some one, like Mr. Spender I hope, who could be a permanent member of the staff to carry on permanently work such as he has been doing during the last few months, it would be one of the best things the Society could ever do.

The President has left it for me to ask you now to accord a hearty vote of thanks to Mr. Spender, and at the same time congratulate him on the very admirable work which he and his colleagues did in photography on the Mount Everest Reconnaissance Expedition of 1935. We must thank also Professor Nørlund, the eminent Director of the Danish Geodetic Institute, for his kindness in releasing Mr. Spender to go on the Expedition, and in lending the Zeiss photo-theodolite which, with our own Wild, played principal parts in the enterprise.

THE THIRD COMMISSION OF THE R.R.S. *DISCOVERY II*:

A paper read at the Evening Meeting of the Society on 18 May 1936, by

N. A. MACKINTOSH

DURING the past few years the Society has received several communications on the work of the Discovery Committee's ships in the Antarctic. In 1928 Professor Hardy described the voyages of the R.R.S. *Discovery* and the modern methods of oceanographical research which are employed on our expeditions, and accounts of the first and second commissions of the *Discovery II* were subsequently given by the Director of Research, Dr. Kemp, and by Mr. Dilwyn John. In each of her three commissions the *Discovery II* has broken new ground, but the methods of research, both in theory and technique, have changed little, and since these methods have been fully described in previous papers I will deal with them here only very briefly. It will be remembered that our principal task is to make an oceanographical survey of the Southern Ocean, investigating more especially the physical and biological conditions which have a direct or indirect influence on the distribution of whales. The essence of this work consists in taking samples, at selected points, of the water and the animal and vegetable life contained in it, and in constructing from these samples charts which show the distribution of organisms and of the varying physical and chemical conditions of the water. Samples of the plankton, or small forms of animal and vegetable life, are collected in fine-meshed nets which can be fished and closed at any required depth, and samples of sea-water and measurements of temperature are taken with water-bottles which can be lowered to, and closed at any depth. Every position at which the ship stops to work nets and water-bottles and to take other observations is called a station, and as a matter of routine one or two stations, or sometimes more, are worked every day wherever the ship goes.

The programme for each commission also provides for some more strictly geographical work. Thus a month is usually devoted to topographical survey work and there are frequent opportunities at other times to make small corrections to the existing charts. Soundings of course are of great importance, both in the routine oceanographical work and in survey work. The echo-sounders have now entirely superseded the Lucas machine, and as long as the ship is at sea routine soundings at short intervals are taken day and night. The *Discovery II* is now equipped with a shallow-water super-sonic machine with an automatic recorder, and an "oceanic" machine also provided with a recorder. The former, which is the more accurate, will take soundings to a depth of 230 fathoms and the latter to the greatest ocean depths. Our most recent investigations in the *Discovery II* will perhaps be more clearly understood if I recapitulate very briefly the progress which had been made up to the time of our sailing in 1933. From 1925 to 1927 the stations worked by the R.R.S. *Discovery* were mainly on the whaling grounds of South Georgia and the South Shetland Islands, and other lines of stations were run across the waters of the Falkland Islands Dependencies, and between the Dependencies and South Africa. Similar work was done later by the *William Scoresby*, and by the time the *Discovery II* sailed on her first commission in 1929 we had the material for a fairly extensive knowledge of the hydrology and plankton

Mount Barnard, Livingston Island, S. Shetlands

"Discovery II" in Admiralty Bay, S. Shetlands

The settlement at Tristan da Cunha

Sunrise at Tristan da Cunha

of the Scotia Sea and whaling grounds of the Dependencies. With the extension of the Antarctic whaling grounds which followed the adoption of pelagic whaling the scope of the investigations has been greatly widened and now covers the whole of the Southern Ocean. In the first commission of the *Discovery II* a large part of the work was again in the Falkland Islands Dependencies, but stations in Antarctic waters extended from Bouvet Island in the South Atlantic to the Bellingshausen Sea in the south-east Pacific, and much of the time was spent in examining the conditions along the fringe of the pack-ice between these limits. The second commission included a complete circumnavigation of the Antarctic in the form of a series of V- and W-shaped tracks across the Atlantic, Indian, and Pacific sectors of the Southern Ocean. By means of these cruises we have been able to fix the limits of the Antarctic and sub-Antarctic zones, and to determine the more general hydrological characteristics of the whole Southern Ocean. It might be said that the main field of our investigations is a belt of ocean some hundreds of miles wide bounded to the south by the edge of the pack-ice. It is seldom necessary for the ship to enter the ice. She is well able to do so, but even in open pack it is difficult or impossible to work the nets and water-bottles, and progress is so slow that much time is wasted. The pack-ice nearly always has a well-defined northern edge, but tongues and outlying belts are occasionally met with, and then there may be some advantage in pushing through the ice to save a long detour.

The third and most recently completed commission of the *Discovery II*, which is the subject of this paper, began in October 1933, and it was arranged that our work should be continued mainly in the Pacific and Atlantic sectors of the Antarctic. The scientific staff on this occasion consisted of Dr. Hart and myself as zoologists, and Mr. Herdman and Mr. Clowes as hydrologists. The photographs illustrating this paper were taken by Mr. A. Saunders.

We had been asked to leave mails at Tristan da Cunha on the way out, and this we were able to do without much loss of time on the way to South Georgia. We anchored off Tristan da Cunha early on November 16 and were fortunate enough to catch a glimpse of the whole island before the higher parts became obscured by cloud. It is a vast cone rising steeply to some 7000 feet, and the only habitable part is a strip of level ground about 2 miles long and half a mile wide at the foot of the cliffs on one side of the island. We met with calm weather on our arrival and were able at once to unload stores which were taken ashore in the islanders' canvas boats. The advent of a ship is always a great occasion at Tristan, and although we arrived there before dawn the boats were pulling towards us before we came to anchor. The men show remarkable skill in beaching their frail-looking and heavily laden boats on the steep and stony beach which affords the only landing-place. After the stores had been distributed and a medical inspection carried out by our surgeon, Dr. Purser, we resumed our voyage towards South Georgia. Routine scientific work was now begun, and the ship was stopped "on station" every evening until on November 28 we reached South Georgia. The *Discovery II* cannot be said to have a base anywhere in the south, but she calls perhaps more often at South Georgia than anywhere else. Supplies of fuel can be obtained from the whaling companies, minor repairs can be carried out, and there is accom-

modation ashore for spare articles of equipment and surplus stores. We stayed there for a few days, and after some work on the local whaling grounds proceeded south-westwards past the South Shetland Islands and into the Bellingshausen Sea.

Fig. 1 gives an almost complete picture of our movements during the whole commission. One of the most important things we had set out to do was to

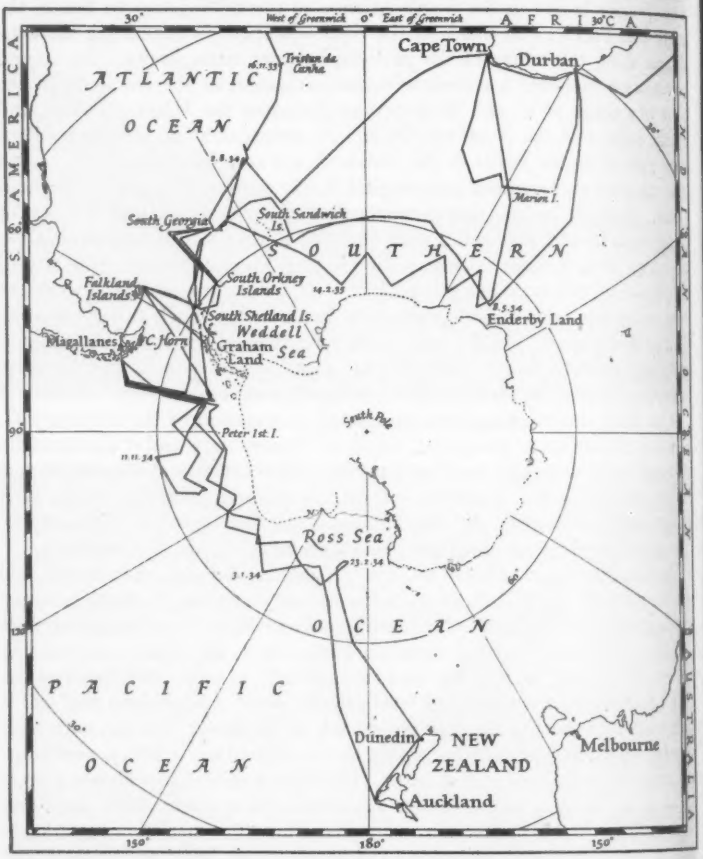


Fig. 1

examine certain seasonal changes which take place in the Antarctic. The range of temperature between summer and winter is only one of many things to be considered. Changes in the flow of the currents, the quantities of salts and gases dissolved in the water, and the shifting of the northern fringe of the pack-ice are all to be sought for, and profound changes take place at different times of year in the amount and distribution of the "plankton" or small organisms swarming in the water. For this line of investigation we planned

to work a series of stations along a chosen meridian and repeat them at intervals throughout the commission. For various reasons it was decided to work these stations in 80° W., and we therefore made for the edge of the pack-ice in that meridian. Then, working two full stations a day, we ran due north until past the latitude of Cape Horn and turned eastwards through Magellan Straits and on to Port Stanley in the Falkland Islands. This line, which we covered five times during the commission, crosses Antarctic and sub-Antarctic water, and cuts across the system of currents flowing into the Drake Strait between the South Shetland Islands and Cape Horn. On nearly every occasion we were fortunate in having comparatively calm weather. During this and previous commissions the Discovery Committee's ships have often worked in the neighbourhood of Cape Horn, and in our experience really bad weather there has been the exception rather than the rule. Gales were of course met with from time to time, but there seems little doubt that this region is not actually more liable to storms than other parts of the Southern Ocean between 50° and 60° S. Its evil reputation probably results from the fact that no regular shipping route has passed through the worst part of the Southern Ocean except round Cape Horn.

On December 27 we left Stanley on a south-westerly course and met the ice-edge not far from our previous line in 80° W. Our task now was to examine the whale population and its environment in the Pacific sector of the Antarctic, and it had been decided that the best method would be to follow a zigzag track covering a belt of sea extending some 200 miles to the north of the ice edge. Our course may be followed in Fig. 1. After working a station close to the pack-ice the ship would steam north-westwards for about thirty-six hours and then south-west until she met the ice again. A full station was worked every evening and a reduced station each morning. At that time of year there is little or no darkness and we were able to keep a continuous look-out for whales. The Pacific sector is the least-known part of the Antarctic. In the early days of Antarctic exploration it was visited by Cook and von Bellingshausen, and later by de Gerlache and Charcot, but between the longitudes of 75° and 150° W. no ship has succeeded in penetrating the ice and sighting any part of the Antarctic continent. It seems probable that in some way the pack-ice in this region stagnates, and that instead of breaking up in summer and drifting out to be melted in warmer water, a large part of it is locked up, perhaps for several years. By further freezing and by the consolidation of layers of snow, the floes would then become so thick that no ship could break through them.

Our zigzag course was continued as far as 160° W., and here we turned northwards to New Zealand, reaching Auckland at the end of January. While there we received a message from Admiral Byrd, whose expedition was then preparing to winter on the Ross ice-barrier, asking if it was possible for us to take a surgeon to join his party. Our next move would in any case be towards the north-eastern part of the Ross Sea, and we therefore embarked a doctor and a considerable quantity of stores, and sailed for the south again after a hasty call at Dunedin. It was arranged that the American expedition's ship, the *Bear of Oakland*, should leave the Bay of Whales and meet the *Discovery II* in about 72° S., 171° W. Our southward voyage was attended

with fine weather and we reached the rendezvous without delay. It need hardly be said that to transfer about 100 tons of stores from one ship to another in mid-ocean is no easy task, and the fact that the whole enterprise was carried through without a hitch is largely to the credit of Captain Nelson, who arranged the details of the meeting. Fortunately there was sufficient ice in the vicinity to suppress the swell, but not enough to hinder the manoeuvres, and the two ships were actually able to come alongside. The wireless direction-finder was of the greatest value on this occasion. The ships were in constant wireless communication during the days preceding the meeting, and the *Discovery II* was able, by means of the direction-finder, to adjust her own course and to inform the *Bear of Oakland* of the relative positions of the two ships. At the time the *Bear of Oakland* finally came in sight snow was falling and visibility was less than a mile.

After this episode the *Discovery II* again skirted the Pacific pack-ice, this time from west to east. The ice had now retreated and we were able to work a little farther to the south; in fact between 160° and 120° W. we were cruising 200 or 300 miles south of the highest latitudes reached by the older expeditions. It appears however that a short time earlier the Norwegian ship *Thorshaven* covered very much the same ground. We had hoped that soundings here might give some indication of land to the south of us, but at the most southerly point we reached after leaving the Ross Sea we still found deep water. This was in 71° 25′ S., 143° 37′ W., and the sounding was 4300 metres. The weather in these latitudes in summer is much more settled than in lower latitudes between 50° and 60° S., and our outward voyage through the Pacific had been exceptionally calm. On the return voyage too we had no cause for complaint, but we met with one gale while steaming south-eastwards between 110° and 100° W. It blew from the south-west, raising a heavy sea, and had it been only a little stronger we should have been obliged to heave to. The ship was rolling heavily and the torrents of spray that broke over the decks quickly froze. In a few hours the whole of the ship's superstructure and every inch of rigging was thickly coated with ice. Frozen spray is common enough, but none of us, I think, had seen it develop to such an extent as this. Ice covered the bridge and masts and even the funnel, and the ship's side was covered with solid ice in places a foot thick.

On March 8, near Peter I Island, in the Bellingshausen Sea, we experienced one of those rare and brilliant days when the life and scenery of the Antarctic are seen at their best. There was a light southerly wind, and the atmosphere was so clear that in the early morning the island was visible at a distance of about 100 miles to the east. Peter I Island is one of the remotest and most isolated islands in the world, and though only a few miles long its ice-covered slopes rise to about 4000 feet. In the bright morning sunshine whales could be seen blowing in every direction, their spouts standing out clearly over the hard line of the horizon. In the afternoon of that day we saw all the early stages in the freezing of the sea. During this commission we were able on more than one occasion to watch the formation of ice in the open sea. It is not necessary for the water to be calm, though still water will no doubt freeze more easily. The first indication is the appearance of a scum formed of minute ice crystals which looks very much like a film of oil on the water. On this

The "Bear of Oakland" alongside "Discovery II" in the Ross Sea

Departure of the "Bear of Oakland"

"Discovery II" in the pack

Early stage in formation of "pancake ice" in the open sea

day we saw it first in streaks and patches, and as we steamed on, it increased and spread over the whole surface of the water. Small disks of ice form in the scum and coalesce, and by jostling together form the familiar pancakes with their upturned edges. Two months later we saw the same kind of ice-scum extending over a much wider area near Enderby Land, but north of Peter I Island it seems that a limited patch of new ice was forming and spreading, and by passing across it we saw in the space of an hour or so the transition from clear water to pancakes about 6 feet in diameter. The main body of the pack, consisting of course of older and much heavier ice-floes, lay not far to the south of us. Its edge must have run north-eastwards, for later in the same afternoon we came up with it again and the new ice was left behind. We skirted it for a day or two and then turned north for the Magellan Strait, repeating on the way our line of stations in 80° W.

During the latter part of March we made two more lines of stations across the Scotia Sea. This brought us to South Georgia in April, and to conclude the first season's work we undertook another long cruise to the south-east, past the South Sandwich Islands and on towards Enderby Land. In late autumn the pack-ice still lies far to the south, and we reached a point in 64° 38′ S., 44° 16′ E. before turning north to Durban and Cape Town. The advance and retreat of the pack-ice in summer and winter is of great importance to the distribution of whales, but although the position of its northern edge can now be predicted with some confidence at any time in summer, comparatively little is known about its movements in winter. It seems certain however that it is farthest north in late winter or spring and farthest south in late summer. Late February or early March is probably the time at which clear water is most likely to be found in high latitudes. Later on the ice-edge advances in some places by the formation of new ice, and in some places by the northward drift of older ice which is no longer kept in check by melting.

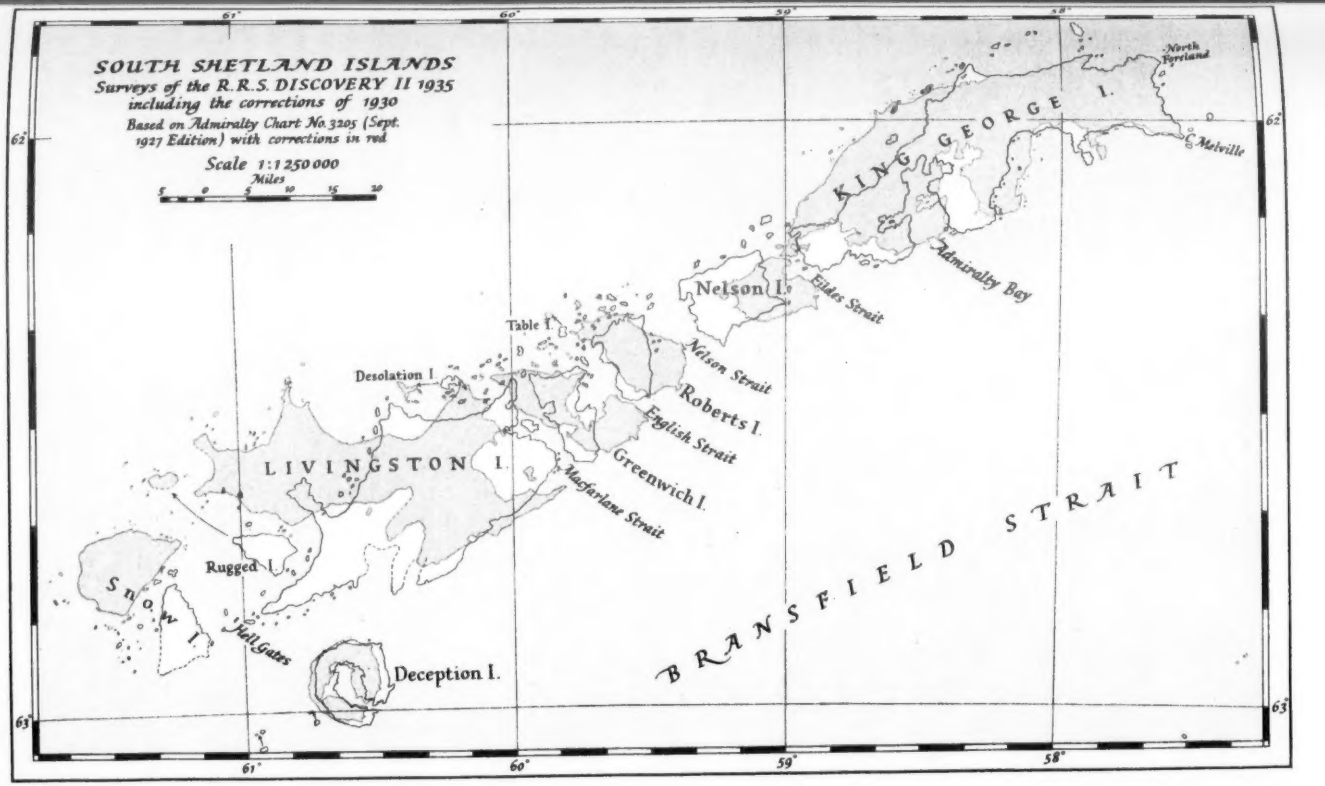
At the Cape the *Discovery II* underwent her annual refit, and on 1 August 1934 she sailed again for South Georgia. The next four months were spent in working various lines of stations in the waters of the Falkland Islands Dependencies, in some repetitions of the line in 80° W., and in other work in the south-eastern Pacific. This was not the pleasantest part of the commission, for it was a period of unusually persistent bad weather—rarely severe enough to stop all work, but seldom remaining comparatively calm for more than a day at a time. The work however was of considerable importance, especially that in August and September. These are winter months and the information we had gathered in previous commissions as to the conditions prevailing in winter was small in comparison with our experience of the spring, summer, and autumn. In December we had planned to continue the survey of the South Shetland Islands which had been begun in 1931. The British Graham Land Expedition under Mr. Rymill were at this time ready to establish their main base near Graham Land, and it had been arranged that the *Discovery II* should assist them by transporting a large part of their equipment from the Falkland Islands to Port Lockroy in the Palmer Archipelago. About the end of November therefore we called at Port Stanley and took on board the aeroplane, dogs, and stores which had already arrived there by mail boat. Mr. Rymill's ship, the *Penola*, reached Stanley while we were

there, and a few days later, on December 2, we sailed again for the south. The *Penola* was to follow later, but Mr. Hampton and Dr. Bingham accompanied the *Discovery II*.

The passage from the Falklands to the groups of islands around Graham Land is not long, but one must be prepared for the worst of gales. Fortunately, in view of our heavy deck load, we met with comparatively calm weather and passed the sheltering chain of the South Shetland Islands without being delayed. Such hold space as we had was filled to its utmost capacity and the decks everywhere were piled high with cargo. Two square spaces had been cleared for the dogs, one on the forward well-deck and one aft, but from the first day out we encountered head winds and the forward pen received such a deluge of spray that the dogs had to be removed and tethered in the covered alley-ways communicating with the after part of the ship.

Passing Smith Island at the western end of the South Shetland Islands we proceeded to the Palmer Archipelago, intending to go straight to Port Lockroy, but we found the channels leading to the harbour were filled with ice and consequently had to postpone landing our cargo. It might be days or weeks before the channels were free, and it was therefore decided to proceed with the surveying of the South Shetland Islands. We turned back to Deception Island and landed Mr. Hampton and Dr. Bingham with the dogs at the old whaling station there. Captain Nelson then began work on MacFarlane Strait, which separates Livingston Island from Greenwich Island. During previous commissions as chief officer of the *Discovery II* under the late Commander W. M. Carey, Captain Nelson had carried out surveys of the South Sandwich and South Orkney Islands and had begun a survey of the South Shetland Islands by fixing the positions of some of the most westerly islands of the group.

The South Shetland Islands (Fig. 2) lie about 450 miles south-east of Cape Horn, and were discovered by Mr. W. Smith in the brig *Williams* in 1819. The group includes a chain of islands running parallel to the northern coast of Graham Land and separated from it by the Bransfield Strait. The south side of the islands is free of outlying rocks, but the northern coasts are fringed by a multitude of rocks and small islands. Many of the latter appear to be formed of a columnar basalt which we did not observe on the south side. The majority of the islands are very mountainous, though one or two such as Low Island and Nelson Island are comparatively flat. Smith Island, for instance, rises to 6800 feet, and there are high mountains on the south side of Livingston Island. All except the small islets and rocks are heavily glaciated and bounded by ice-cliffs. At many points however, where rocky promontories or reefs run out from the glaciers, there are sheltered beaches where a landing can be made. In such places we found many elephant and Weddell seals, vast penguin rookeries, and a great variety of other birds. There is in fact an abundance of animal life, though the flora is almost restricted to a few mosses and lichens. Fur seals were plentiful at one time, but they were virtually exterminated by the sealers who visited the islands shortly after they were discovered. The South Shetland Islands are well known to the whalers. For many years the harbour at Deception Island was occupied during the summer season by a number of factory ships, while the whale catchers hunted


SOUTH SHETLAND ISLANDS
Surveys of the R.R.S. DISCOVERY II 1935
including the corrections of 1930
Based on Admiralty Chart No. 3205 (Sept. 1927 Edition) with corrections in red
Scale 1:1 250 000
Miles
5 0 5 10 15 20
61°
60°
59°
58°
62°
63°
North Foreland
KING GEORGE I.
Melville
Admiralty Bay
Nelson I.
Elides Strait
Table I.
Nelson Strait
Roberts I.
English Strait
Greenwich I.
Macfarlane Strait
Desolation I.
LIVINGSTON I.
Rugged I.
Snow I.
Hell Gates
Deception I.
BRANSFIELD STRAIT

in the Bransfield Strait and to the north of the islands. However no proper survey of the region had been made, except for Deception Island, which was charted by Charcot, and the charts were in many places extremely inaccurate and unreliable. In Fig. 2 the outline of the islands as it appeared in the charts before the surveys by the *Discovery II* is contrasted with the newly ascertained shape of the coast-line. As on previous occasions the method of running survey was adopted, but certain points such as Yankee harbour in MacFarlane Strait, Harmony Cove in Nelson Strait, and Visca anchorage in Admiralty Bay were accurately fixed by a series of astronomical observations taken by small parties which camped for a day or two ashore. Four of us were ashore at Harmony Cove. It is a bay at the junction of the ice-cliffs and an area of low rocky ground which at that time was largely clear of snow. In bad weather it can be bitterly cold on an open beach in the South Shetlands, but during the three days we spent here there was not a cloud in the sky, and our principal concern was to protect our skin from the brilliant sun which shone from two in the morning till ten at night. No shade was to be found except inside the tent, which became unpleasantly hot during the day. Some distance along the beach were some large rookeries of Gentoo and Ringed penguins, mostly with half-grown chicks. At one point there was a short stretch of beach alive with elephant seals. It was bounded by rocky hillocks covered from top to bottom with penguins, and on the slopes of scree and rocks behind, giant petrels, Cape pigeons, Wilson's petrels, and skuas were nesting. The air was full of Dominican gulls and skuas, the latter quarrelling and tilting at each other on the wing, and the whole scene was one of crowded life which presented an astonishing contrast to the desolation of the inland ice-fields.

The time available for surveying was devoted to the eastern part of Livingston Island, the islands and channels between Livingston and King George Islands and a part of King George Island. Some work remains to be done on the eastern part of the latter island, and on Elephant and Clarence Islands, which are separated by some distance from the other islands. Echo soundings of course played a large part in these surveys, and the recording apparatus was in continual use. Apart from supplying vast numbers of soundings for the new charts, this instrument is of great assistance to the surveyor who is aware of every change in depth from moment to moment as he approaches unknown anchorages or picks his way between rocks or through narrow channels. Soundings around these mountainous islands change with alarming rapidity, and the northern coasts particularly are a nightmare to the navigator. On this side strong currents set through the entrances to the passages between the islands and the whole region bristles with needle-like rocks. The surveying was concluded on 9 January 1935, and we then returned to Deception Island. Hampton and Bingham had stayed there at the deserted whaling station, and had been busy laying in a large stock of seal meat to feed the dogs during the winter. They now rejoined the ship, the dogs were taken on board again, and we sailed for the Palmer Archipelago. This time the channels were free of ice and we steamed down de Gerlache Strait and the Neumayer Channel, and anchored in Port Lockroy. This is little more than a bay in the ice-cliffs of Wiencke Island, but it offers a sheltered anchorage for a small

ship. There are two small islands in the harbour, and on one of these the aeroplane, the dogs, and the stores were landed. Some days were occupied in unloading the stores, for everything had to be taken ashore in the lifeboats. On January 19 the *Discovery II* left for South Georgia and the *Penola*, which had been delayed in the Falkland Islands through engine trouble, reached Port Lockroy a few days later.

Leaving South Georgia on February 7 we undertook another long voyage, this time south-eastwards to the whaling grounds off Enderby Land and then north to Cape Town. Our route took us past Cook Island and Thule Island in the South Sandwich group, and some days later we reached the pack-ice in 68° 45′ S., 09° 20′ W. As in the Pacific sector we followed a zigzag course to the north of the ice-edge and passed across the area in which the whaling fleet was at that time working. The majority of factory ships now work in this part of the Antarctic. In the early part of the season, when the ice-edge is far to the north, they are widely scattered along its edge through the Atlantic and Indian Ocean sectors. In December or January however the ice breaks up very quickly and the whalers move southwards and tend to become more concentrated in the vicinity of Enderby Land, about 2000 miles south-south-east of the Cape. We saw large numbers of whales on some parts of this area, and on several occasions we came in sight of factory ships or their catchers. The weather was unusually fine and we were able to gather some material by which to compare the conditions on this recognized whaling ground with the conditions in other places where we had seen whales such as in the Pacific sector. At this time Mr. G. W. Rayner was marking whales in the *William Scoresby* in the same part of the Antarctic. The two ships did not actually meet though they were sometimes within 100 miles or so of each other (a very short distance in those regions), but to their mutual advantage they were in constant wireless communication. The *Discovery II* kept the *William Scoresby* informed of the numbers of whales she saw, and the *William Scoresby* was able to work some most useful stations to supplement those of the *Discovery II*.

When we reached the Cape the commission was nearly at an end. There was not sufficient time to make another long cruise to the ice-edge, but in order to gather some more information on the complex system of currents to the south of South Africa we made a short cruise to the little-known Marion Island and north again to Durban. Marion Island, together with its smaller neighbour, Prince Edward Island, lies about 1000 miles south of Durban. It was discovered in 1772 and was visited by the *Challenger* in 1873. Few other ships have been there. It is about 12 miles long and over 4000 feet high, and there is an abundance of bird life there. Stormy weather made it impossible for us to land, but we were able to do some dredging and trawling on the lee side of the island before turning north to Durban. On April 19 we began the homeward voyage by way of the Indian Ocean and Suez Canal, and made a long line of stations between Durban and the Red Sea. Here the usual hydrological observations were made, and large tow-nets were fished in deep water. The hydrological work has settled several important problems connected with the current systems and water masses of the western Indian Ocean, and the catches from the nets have provided valuable information on the distribution of some of the larger planktonic organisms.

It is the object of this paper not only to give a general account of our recent voyages, but also to show something of the results of our investigations. The work of course is many sided and the material and data accumulated in the course of a commission subsequently require prolonged examination and analysis. Certain results however can be reached at an early stage, and by taking one or two examples of these from different aspects of the work I hope to give some idea of the methods followed in this type of research. It has already been explained that the work largely consists in mapping out the distribution of the physical conditions or of the forms of life in the sea. This is done in very much the same way as an isobaric chart, with contours representing lines of equal pressure, and drawn up from a large number of barometer readings taken at widely scattered points. We can construct charts, for instance, to show variations in some particular area of the temperature or salinity, of the quantity of the whales' food or of other constituents of the plankton. It is desirable of course to have as many observing points as possible, and therein lies the advantage of a full-powered ship with a long cruising range.

Charts of distribution can be made in both the horizontal and the vertical plane. A simple example of the former was a series of charts which were drawn up to cover all the zigzag cruises off the ice-edge. These were not quite typical of the contoured chart made up from scattered observations, but will illustrate well enough the reason for comparing the distribution of a form of marine life with its physical environment. Every whale observed during these cruises was plotted as a dot on these charts as precisely as possible in the position at which it had been seen. On the same charts the distribution of surface temperature was represented by isotherms (or lines of equal temperature). The isotherms were derived from the thermograph, an instrument which keeps a continuous record of the surface temperature in much the same way as a barograph records changes in the atmospheric pressure. From these charts it was seen that in certain circumstances the appearance of whales was restricted to a limited range of sea temperature, and it appears that the coldness of the water may act as a limit to the southward movement of at least one species of whale. Where tongues of cold water, for instance, project northwards from the edge of the pack-ice the whales are often segregated in the patches of warmer water between them. A difference in the sea temperature of less than 1° C. may have an important effect on many forms of marine life, and in work of this kind it is therefore necessary to measure temperatures with great precision.

An example of the use of charts in the vertical plane may be taken from the lines of stations in 80° W. Perhaps the most important conclusion so far derived from these repeated observations is one which concerns the vertical circulation of the plankton. Each line on this meridian included from seven to ten stations, and the routine at each station included a series of six or seven vertical hauls with closing plankton nets from various depths between 1000 metres and the surface. The plankton in a sense is a nebulous mass of food material on which all forms of marine life are directly or indirectly dependent, and the samples from these nets have demonstrated a large-scale migration of the plankton which may be of great importance in our understanding of its distribution.

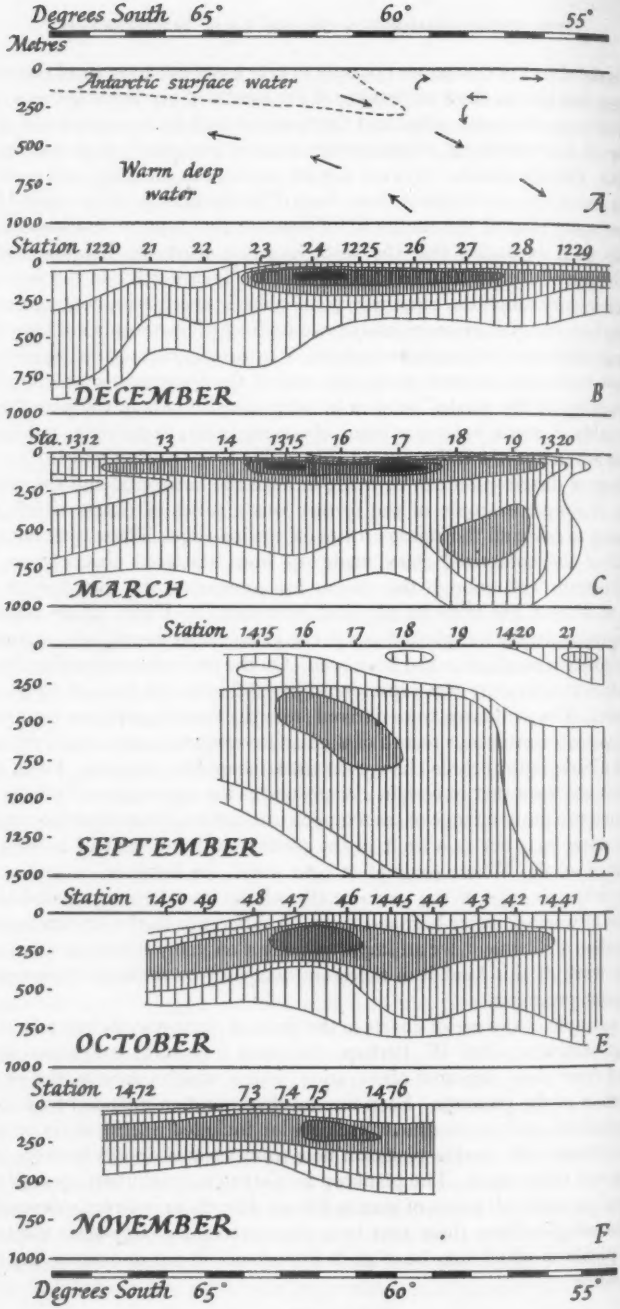

Degrees South 65° 60° 55°
Metres
0
250
500
750
1000
Antarctic surface water
Warm deep water
A
Station 1220 21 22 23 24 1225 26 27 28 1229
DECEMBER
B
Sta. 1312 13 14 1315 16 17 18 19 1320
MARCH
C
Station 1415 16 17 18 19 1420 21
1250
1500
SEPTEMBER
D
Station 1450 49 48 47 46 1445 44 43 42 1441
OCTOBER
E
Station 1472 73 74 75 1476
NOVEMBER
F
Degrees South 65° 60° 55°

Fig. 3

In the Antarctic zone three layers of water can be distinguished. At the surface is a thin layer of cold water varying in depth from 100 to 250 metres. Below this is a very much thicker layer known as the warm deep water, and below this again is the Antarctic bottom water. Except in high latitudes the general drift of Antarctic water is from west to east, but there is a northerly component in the movement of the surface and bottom layers, and a southerly component in the movement of the warm deep layer. This means that a particle of water in the surface layer will gradually move northwards from a high latitude in the Antarctic until it reaches the Antarctic convergence, though it might travel a considerable distance to the east in doing so. The Antarctic convergence is the northern boundary at which the cold Antarctic surface water dips below the warmer sub-Antarctic water. Similarly a particle of water in the warm deep layer gradually works its way south until it rises to the surface or sinks to the bottom layer in a high latitude. Fig. 3, *a*, is a vertical section of the ocean in the meridian of 80° W., and shows diagrammatically the movement of the surface and warm deep waters. Fig. 3, *b–f*, shows on the same scale the distribution of the small crustacean *Rhincalanus gigas* as ascertained by the closing plankton nets in the various months in which the line of stations was repeated. This species is one of the most important constituents of the Antarctic plankton, and was actually the most abundant of the larger organisms in this region. It will be seen that in December and March it is concentrated mainly at the surface where the water is moving northwards, though there is some tendency to sink into deeper water in the latter month. In September however, the coldest part of the winter, it has deserted the surface and is practically confined to the warm deep water which is moving southwards. In the spring (October and November) it has largely regained the surface water. Every species does not behave in the same way, but if we draw similar diagrams for the total volume of the plankton, or for the total numbers of at least the larger organisms, we see the same concentration at the surface in summer and the same sinking into deeper water in winter.

In the past nearly all plankton work in the Antarctic had been done in summer, and *R. gigas* and many other species appeared to be typical inhabitants of the surface waters. Plankton organisms however have not the strength to swim against the currents, and it was recognized that if the majority of a species lived in the surface layer, they would be carried northward like the particle of water mentioned above, and that if such species had no means of returning to their starting-point they would soon be cleared out of the Antarctic surface water altogether. The means by which these organisms maintain the ordinary limits of their distribution has thus for long been a matter of conjecture, and it had been suggested that they might make use of the southward-going warm deep water either at some particular time or at some stage in their growth. The material taken from the stations in 80° W. now seems to show that a considerable number of species do in fact use this south-going current to get back, as it were, to the start. It appears certain that they are carried northwards in summer in the north-flowing surface water, and return south again in winter in the south-going stream at depths of 400 metres or more.

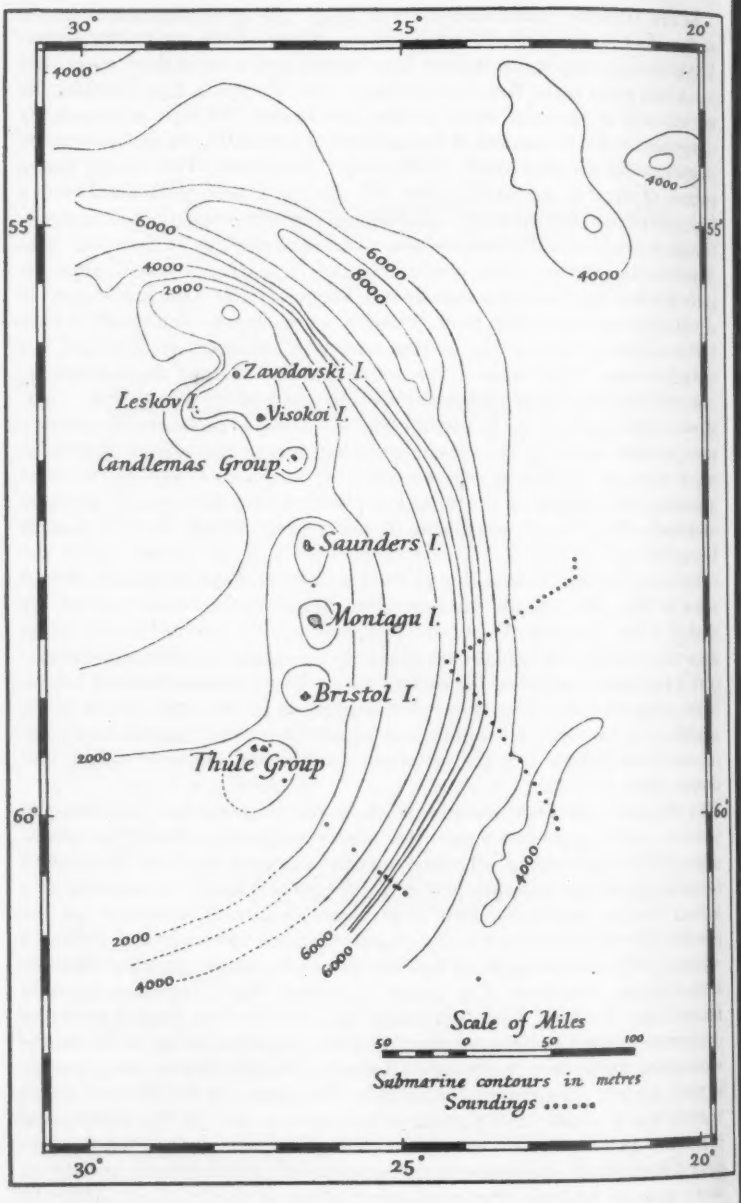

30°
25°
20°
55°
60°
4000
6000
8000
2000
Zavodovski I.
Leskov I.
Visokoi I.
Candlemas Group
Saunders I.
Montagu I.
Bristol I.
Thule Group
Scale of Miles
50 0 50 100
Submarine contours in metres
Soundings .....

Fig. 4

During each commission we are able, by means of routine soundings, to add much to our knowledge of the depth contours of the Southern Ocean. Perhaps the most interesting region we examined on this occasion was the South Sandwich Deep. To the north and east of the South Sandwich Islands the *Meteor*, and later the *Discovery II*, had obtained several soundings exceeding 7000 metres, and one or two of more than 8000 metres. The South Sandwich Group is a chain of volcanic islands, and the deep was seen to be in the form of a curved trough lying parallel with the islands. After leaving South Georgia for the Cape in April 1934, and again in February 1935, we took lines of soundings farther to the south and were able to trace a remarkable southward extension of the trough. Mr. Herdman has plotted the new soundings and the resulting contours, and these are shown in Fig. 4. To the northward the deep is comparatively broad, and comes to an end about latitude 55° S., but to the southward we have yet to find the end of it. The last line of soundings shows it to have narrowed to an extraordinary elongated cleft in the sea floor, still exceeding 7000 metres in depth, which must, I think, be unique among the great ocean deeps so far discovered. It seems probable that beyond 60° S. the South Sandwich Deep continues to curve round towards the west, and it is to be hoped that the *Discovery II* will find opportunities in the future to trace it yet further. Unfortunately soundings are not easily obtained to the south-west of these islands as this is a region which is seldom free of pack-ice.

The technique of oceanic sounding has made enormous strides in recent years, thanks to the development of echo-sounding machines. With the ordinary oceanic machine soundings in great depths can be taken in a few seconds while the ship is still steaming at full speed. Soundings in similar depths with the old Lucas machine took several hours with the ship stopped. Furthermore they were less accurate and great lengths of wire were frequently lost. The echo-sounding recorder, which automatically traces the contour of the sea bed as a continuous line on a moving scroll of paper, is quite a recent invention. It served us well during the past commission, but will probably undergo great improvements during the next few years. Its chief value of course lies in the fact that by taking a sounding every two seconds it records in a permanent form all the sudden changes in depth and the smaller irregularities in the bottom which would be missed by intermittent soundings with the ordinary machines. There seem to be interesting possibilities here in the field of oceanographical research. It is well known of course that some parts of the sea floor are level plains of sediment or sand, and other parts, especially in the vicinity of mountainous land, may be very much ridged and folded. The recorder might well throw light on problems of submarine geology, for it can help us to distinguish between areas of undisturbed sediment and areas of disturbance, of steep slopes and even perhaps of outcrops of rock. Again, the continuation below the sea of certain land formations, such as a ridge formed by a line of intense folding, could probably be traced by the recorder. For instance, Marion Island in the south-west Indian Ocean, which we visited towards the end of the commission, is of volcanic origin, and in this and the previous commission we have found some remarkable fluctuations in the soundings over an area some hundreds of miles to the south-west of it. Stormy weather prevented the use of the

recorder, which at present needs a relatively calm sea for soundings in deep water, but if, as we suspect, a line of volcanic folding runs south-westwards from Marion Island, it could best be traced by means of the recorder.

DISCUSSION

Before the paper the PRESIDENT (Major-General Sir PERCY COX) said: My Lords, Ladies and Gentlemen, The lecture we are going to listen to to-night is the narrative of the Third Commission of *Discovery II*. For the information of those not fully conversant with Antarctic affairs I may say that the *Discovery* is one of the two vessels employed by the *Discovery* Committee in London. The duty of the *Discovery* and the *William Scoresby* is to study the movements and life history and the various food and other aspects of the life of the whale, in connection with the great whaling industry which, as you know, goes on in Antarctic waters.

Dr. Mackintosh, who is going to read the paper to-night, is a zoologist by profession and a member of the scientific staff of the *Discovery*. He has been with the *Discovery* for ten years or more and returned from her third commission in June of last year. He is now working at the British Museum on the results of that Commission, especially on the various side issues on the zoological side arising from the work of the Commission. I now ask Dr. Mackintosh to read his paper.

Dr. Mackintosh then read the paper printed above, and a discussion followed.

The PRESIDENT: Dr. Stanley Kemp, we should like to hear some comments from you.

Dr. Kemp, as you know, is the distinguished head of the Zoological and Scientific Staff of the *Discovery*.

Dr. STANLEY KEMP: Mr. President, Ladies and Gentlemen, I think you will agree with me that Dr. Mackintosh has given us an admirable account of the third commission of the *Discovery II* which was carried out under his leadership, and though he has not stressed the point, I think you will have gathered that a great deal of useful work has been done. I should like to add a little to what he has said about the scientific side of the work.

The procedure which we adopt in our investigations in the Antarctic is one which is familiar to scientific workers in many fields. We start with a general survey, as widespread as possible, and that survey, though it will of itself produce very valuable results, will also draw attention to a number of specific problems which must be solved before we can make further progress. The next step, with such information as we have been able to gather, is the formulation of theories that will afford tentative explanations of these problems. And finally the last step is to devise and undertake a special series of observations which will tell us whether these theories are right or wrong. So it has been with this question of the plankton circulation, a problem which has very real economic bearings.

When spring comes in the South, light increases; the drifting vegetation multiplies exceedingly, and so too do the animals which feed upon it. In the spring also, as the ice begins to melt, the surface currents gain strength, and they carry with them towards the north-east all this vast and ever-increasing mass of organic life. We found that out quite early in our work, and the problem was: What happens to it? Do these small animals and microscopic plants, which are responsible for the great richness of Antarctic seas, continue to drift away to the north until they reach temperatures which must inevitably be fatal to them? Are the supplies continually replenished from the south, or is there some way by which the organisms or their descendants can get back again to the latitudes from which they originally came?

Various isolated observations suggested that the organisms might indeed be able to return to the south; but if so they would need to go down to considerable depths, where there is a south-flowing current of warm water. In order to test this theory we arranged the special series of observations in 80° W. The result, as Dr. Mackintosh has shown, indicates that the return movement is a real thing, at any rate for some of the species, and it is very probable that it is true of the greater part of them.

Dr. Mackintosh has thus demonstrated the existence of a most impressive circulation of the plankton extending over probably some 500 or 600 miles of latitude and to a depth of very nearly half a mile. I think I am right in saying that no regular plankton movements of such vast extent have been known before. Now this discovery, as you will observe, has meant a very great deal of extremely hard work. A line of stations 600 or 700 miles long has to be laid down, and at each station observations must be carried to a depth of at least 1000 metres. And the whole line has to be repeated at least five times in different months, in seas that are probably the stormiest in the world, before one can trace the seasonal changes. Dr. Mackintosh, I was glad to see, showed us some pictures of stormy weather. Usually we get none at all at these lectures, and that I have hitherto regarded as some sort of a scientific phenomenon—that the urge to take photographs is very closely associated with fine weather!

I have only referred to a single item in the work which was carried out during the third commission. Dr. Mackintosh has spoken of others and in many ways he has made great advances in our knowledge. Moreover in the quantities of data that he has collected and brought home there is material for many fine discoveries yet to come. I congratulate him and all those associated with him on the very great success of the work.

The PRESIDENT: Dr. Mill, may I ask you to come up on to the platform? Dr. Mill is our great authority on Polar questions, both North and South.

Dr. H. R. MILL: It has been my good fortune to speak after many papers on the Antarctic regions, and I have, as a rule, touched on what I thought the most important and to me the most interesting aspect of such researches. I agree with the old College don who proposed a toast: "Pure Science, and may it never be of any use to any one." I have harped upon this string so often that yesterday I had some of the remarks I have made at previous meetings read over to me. I felt that if I were called upon to speak to-night I must say something that was not expected even if it did not represent my deeper feelings on the matter.

During the last fifty years I have been asked one question more frequently than any other: "What is the use of Antarctic exploration? What good does it do to anybody?" I have tried to explain the good it does by the advancement of science, by education, by discipline, by all sorts of fine things, but I found that what was at the back of the minds of my interlocutors was: Is there any money in it? Now I want to show you that that question might have been answered in the affirmative quite accurately if one only had looked into the matter fully.

When the first Antarctic expedition was sent out in 1772 under Captain Cook it was sent to discover a great temperate continent and take possession of it for the British nation. Cook discovered there was no such continent. He went round the world as close to the ice as he could get and came back and reported that "Should any one possess the resolution and the fortitude to elucidate this point by pushing yet further south than I have done I shall not envy him the fame of his discovery; but I make bold to declare that the world will derive no benefit from it."

He discovered one little island which he called picturesquely the Isle of Georgia, and mentioned, incidentally, that it swarmed with seals. Of this little

hint nobody at home took any notice at the moment. The real value of Cook's expedition was, first, that he found a means of driving scurvy out of the British Navy, for which he received the Copley Medal of the Royal Society; and second, the discovery that the newly invented chronometer could keep accurate Greenwich time during a voyage of three years, and so he solved the practical problem of longitude. Both these things have saved millions of money and hundreds of thousands of lives to the seafaring nations of the world.

That little hint about the seals set the shipowners of London and the shipowners of New England to work, and for fifty years after Cook's voyage there were hundreds of little ships swarming round South Georgia and the other islands discovered later, the South Shetlands and South Orkneys, and the fur-seals provided very comfortable livings for a great many people for a good many years. Then the fur-seals were exterminated, or nearly so, and it no longer paid to hunt them.

The next great expedition was sent out in order to correct the magnetic charts of the Southern Ocean, the expedition of Sir James Clark Ross. He improved the magnetic charts and made it possible for ships to navigate the seas safely. Now that work has largely lost its value, for with the Gyro-compass navigators can be entirely independent of terrestrial magnetism. But Ross mentioned, incidentally, that he saw a great many whales in the Ross Sea and other places around the Antarctic circle, and for fifty years nobody paid any attention to what he had said. Then in 1892 some Scottish whalers went out to see if Ross's reports were correct, and they came back and reported that the whales were too big and their own methods inadequate. But Norwegians also went out and, as they had developed a new system of whaling with bomb-harpoons, they founded that great industry of Antarctic whaling which has brought wealth to Norway and also to a great many of the other countries of Europe. That was the result of the Antarctic exploration which Cook believed could never do any good to anybody.

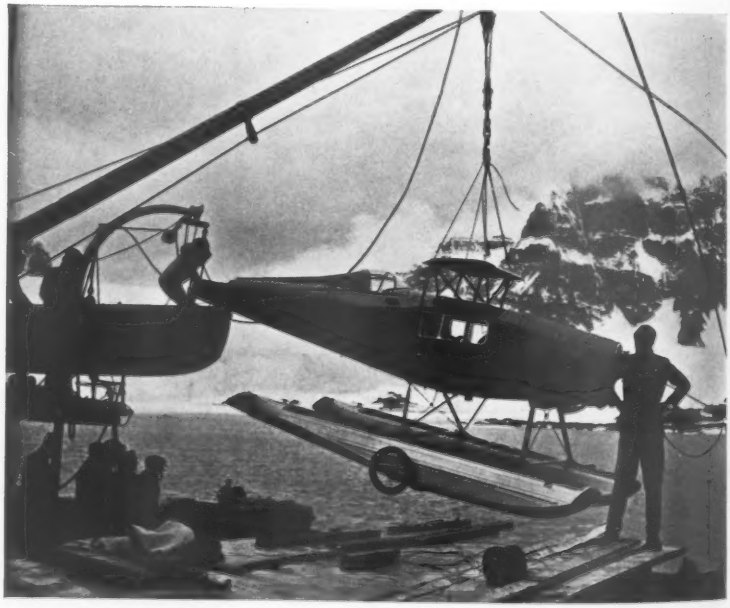
Now comes a little piece of poetic justice. When the Norwegian whalers started their work they required land stations in order to boil down the blubber into oil. The only stations that could be used were those of the Falkland Island Dependencies, and the Falkland Island Government demanded a royalty on the oil obtained and issued licences for carrying on the work. The Norwegians readily paid for the privileges, and when I visited the Falkland Islands in 1912 I found the Governor, Sir William Allardyce, chuckling over the fact that the island treasury which he had found empty was now overflowing; overflowing so much that the British Colonial Office were a little perplexed to know what to do with the money. They came to the extremely wise decision that part of it at least should be devoted to carrying out scientific studies of the whaling industry which had brought in the wealth. So the *Discovery* Committee was started and was conducted on the wisest lines. It has resulted in those magnificent voyages that we have heard described here from time to time, and one of the most important of which we have just had the pleasure of listening to.

The search for the money value of exploration has led to scientific investigation; but the scientific investigation is turning round again, and one of its main objects is to endeavour to make this whaling industry permanent, so that the whale will not be exterminated as the fur-seal was, and that the industry may go on to all perpetuity, producing the margarine for your bread and butter, the soap for you to wash with, and the glycerine to keep your motor radiators from freezing and to yield the explosives essential for your mining and your wars. So great have been the benefits to mankind resulting from voyages of exploration in the Antarctic seas. Of the millions of pounds which now flow annually from these seas to Europe I feel that the most important use is being made of that

Port Lockroy from the glacier above

Peltier Channel and the Sierra du Fief, from above Port Lockroy

Stores landed at Port Lockroy



Unloading the British Graham Land Expedition's aeroplane at Port Lockroy

small fraction which the *Discovery* Committee is allowed to devote to its scientific researches.

The PRESIDENT: We are always glad to hear Dr. Mill on this platform. He is such a master of his subject and always has so much of interest to tell us. You are all glad, I am sure, to have found him in such good form to-night.

We have with us Professor Julian Huxley, the Secretary of the Zoological Society. He reminds me that zoology is his primary interest or concern, but I cannot believe that he can have listened to what has passed to-night without having some interesting observations to make.

Professor J. S. HUXLEY: I am afraid I am here under entirely false pretences. Though a zoologist, oceanographic zoology is a branch I have never prosecuted, so that I have never had the pleasure and privilege of conducting scientific work in such a heaving laboratory as you saw to-night! My only excuse is that Professor Hardy, who was on the first *Discovery* expedition, was my first pupil at Oxford after the war, and I have always been very much interested in his career and work, as well as, in a less personal way, the results which the series of *Discovery* expeditions has achieved.

At the Zoological Society we are particularly interested in the preservation of fauna, and of course the marvellous work which is going on through the *Discovery* expeditions has as its practical aim the regulation of the whaling industry and the conservation of whales. All who listened to-night to the lecturer's brilliant address must have been struck by the way in which scientific work of this sort is changing. In place of the rather haphazard methods of the early years of exploration we get elaborate investigation of the interrelations of the different organisms, the web of their ecology; further, the work is becoming steadily more and more quantitative. As Dr. Kemp stressed, each of those graphs of the plankton cycle which you saw on the screen represented a large number of accurately determined investigations. This quantitative work is becoming a more and more pronounced feature of all branches of biology, and it is only as a result of such long-continued quantitative laborious work that you will get a firm basis for any practical measures.

That brings me to what Dr. Mill was saying. I think that most scientists will wish that work could be entirely in the realm of pure science. But Dr. Mill, at the conclusion of his remarks, rather contradicted his earlier statements, and pointed out that it is in fact impossible to separate pure and applied science, however much you may try. It is impossible because science is both knowing and doing: you cannot separate the two aspects. The results of the *Discovery* expeditions are proof of that. Through them we are getting results of the most fundamental importance in our quantitative knowledge of the life of the sea, results which from one aspect are of purely scientific interest, but which, from another aspect, are the necessary foundation for the conservation of the whaling industry, and indeed of fisheries in general.

The PRESIDENT: I think you will all agree with me that Dr. Mackintosh has made the subject of his paper, which calls for a good deal of science, of great and informative interest to us, interest augmented not only by his pictures but by the flowing ease with which he delivered his lecture. I am sure many of you will remember for the rest of your lives some of his pictures of some of the *Discovery's* "emotions" in swollen seas. We have previously, of course, seen pictures here depicting scenes in the Antarctic, but I do not remember any that have been more realistic or have brought home to us more vividly the terrible punishing conditions under which enthusiastic workers will pursue their task.

I ask you to join me in thanking Dr. Mackintosh very much indeed for his informative, interesting, and very able lecture.

THE ECONOMIC GEOGRAPHY OF SWAZILAND

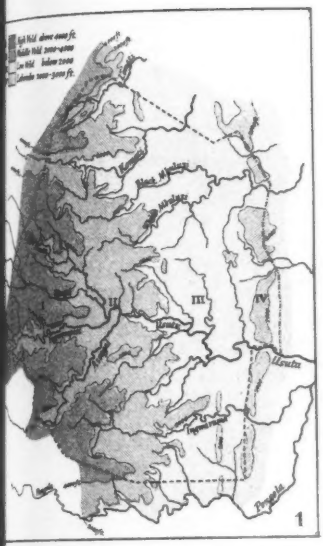
DOROTHY M. DOVETON

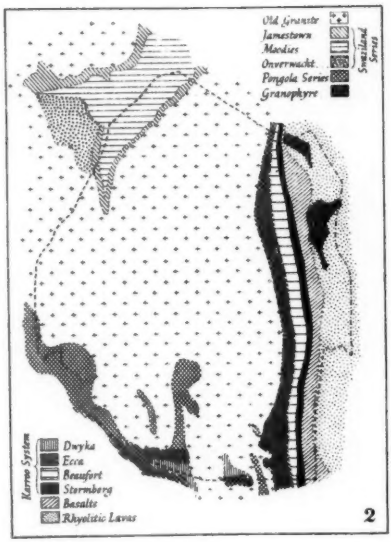
DURING the earlier part of last year a certain amount of correspondence arose once again in the Press concerning the South African Protectorates, and the question of their transfer to the Union. I know little of conditions in either Basutoland or Bechuanaland, but I would like to bring forward some aspects of the geography of Swaziland, in the hope that they may perhaps serve to clarify the issue, at least where this Protectorate is concerned. The territory is about the size of Wales, and since I cannot hope to deal with all the problems, I propose to survey briefly the physical geography and historical development of Swaziland in relation to its economic development. It is this economic aspect which is likely to figure most prominently if and when terms for the transfer of the Protectorate to the Union are drawn up.

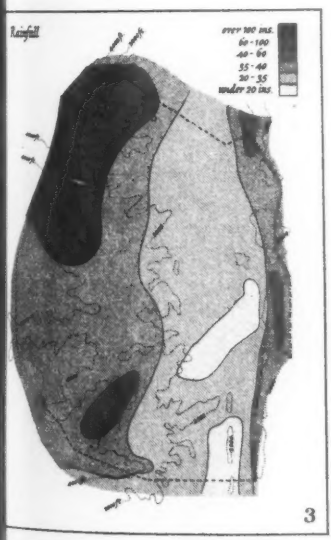
Swaziland lies about 3 degrees south of the Tropic of Capricorn. On travelling through or flying over the country one is struck by the four well-defined topographical units into which the region falls. These physical divisions are determined mainly by geological structure, and themselves give rise to variations in the natural vegetation.

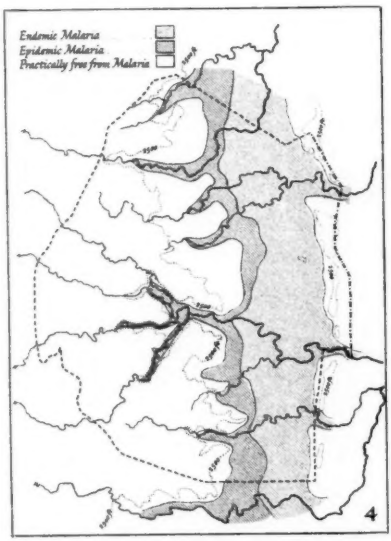
Firstly, in the west the rim of much dissected mountainous country varying from 4000 to 6000 feet above sea-level is known as the high veld. Secondly, east of the high veld there is a perceptible drop into the deep valleys of the broken, rolling middle veld, which lies between 4000 and 1500 feet above the sea. This region is transitional to the third division, the low veld, which stretches eastward, a monotonous practically level plain across which thorn and bush dominate the landscape; this region is sometimes termed the bush veld. This last area varies from 800 to 2000 feet above sea-level, while its continuity towards the sea is broken by the fourth division, the sheer face of the Lebombo rising abruptly from the bush-clad flats to 2500–3000 feet above the sea and forming a continuous range along the eastern boundary of Swaziland, breached only by the narrow but conspicuous gorges worn by the rivers, practically all of which drain eastward to Delagoa Bay. The rivers differ from most South African rivers in one respect which is of great importance—the main Swaziland rivers are perennial, and only those tributaries which rise within the bush veld dwindle to a string of muddy puddles during the dry season (Map 1).

From the geological map it appears that most of Swaziland is built of ancient granitic rocks (Map 2). Since very little is known concerning the geology I do not claim that this map is accurate. The mountainous region on the north-west border is a geological unit, and although the old rocks do not all lie within Swaziland, it is convenient to discuss the mountainland as a whole. From the map one can trace the relationship of the Barberton mountainland to the geology of the surrounding areas. It is a fragment of a series of sedimentary strata, presumably Pre-Cambrian in age, surrounded by the Old Granites, which cover immense areas in Southern Africa. The Pre-Cambrian beds reappear in the south of Swaziland. The Barberton mountainland is a most important physiographic element, for it has a marked influence on


Limpopo
Black Mfolozi
Mfolozi
Tugela
Vaal
Orange
Fish
Buffalo
Umzimkulu
I
II
III
IV
1


Old Granite
Jamestown
Maedies
Onverwacht
Pongola Series
Granophyre
Swaziland Series
Karroo System
Dwyka
Ecca
Beaufort
Stormberg
Basalts
Rhyolitic Lavas
2


Rainfall
over 100 ins.
60 - 100
40 - 60
35 - 40
20 - 35
under 20 ins.
3


Endemic Malaria
Epidemic Malaria
Practically free from Malaria
4

scenery, on water supply, and on economic development owing to the presence of gold. It comprises a great succession of rocks folded into a series of ranges with a general north-north-east to south-south-west trend. The highest portion of the mountainland lies along the Swaziland border. The mountains contrast with the surrounding country. In passing from Piggs Peak to Forbes Reef one descends 2000 feet to the floor of the Komati gorge. The ascent to Forbes Reef is nearly 2500 feet. Where the Quartzites of Havelock Hill cross the Komati, Umkomogaas is 2200 feet above the level of the water. Emlembe in Makonjwa range rises to 6070 feet, while the average height over the ranges varies from 5500 feet to 4500 feet, and the valleys generally reach an altitude of 2500 feet to 3500 feet; a difference of anything from 1000 to 3000 feet.

Many minerals occur within the mountain belt along the line of metamorphism due to contact with the granites (Map 5). Gold occurs in reefs and lodes along a narrow zone of the country, parallel to, but not directly along, the line of contact. This gold-bearing belt is defined by a number of small mines. Alluvial gold is found along the stream beds, and eluvial gold, shed from neighbouring reefs, on high terraces. Another mineral of value is asbestos, which occurs in the serpentines in a wild, inaccessible valley below Emlembe. It is known as chrysotile, and is a white asbestos with a medium fibre. The Pre-Cambrian, sedimentary rocks in south Swaziland build sharp-edged ridges of quartzite separated by wide valleys covered with amygdaloidal diabase. Some of the upper beds may be correlated with the Witwatersrand series, for a quartzite conglomerate is found within them extremely similar to the "banket" rock of the Rand. Gold occurs in this rock, and malachite has also been discovered. The Old Granites are of great economic importance, for it is here that the famous alluvial tin-bearing gravels of Swaziland are found. Cassiterite occurs in the pegmatite veins which traverse the grey granite. In the Forbes Reef area some tin lodes are found *in situ* where the granite has penetrated the schists. Around M'babane the tin is either alluvial or eluvial, and there is no evidence that the parent lodes still exist. The area is very typical of much of Swaziland. It is well watered and deeply dissected by stream valleys. The prominent granitic ridges are crowned with weathered boulders. On their sides are bare bosses of rock. They are separated by long conspicuous valleys which run in a most intricate and bewildering manner. Favourable hydrographical conditions and the well-defined drainage system have facilitated the effective concentration of cassiterite and other heavy constituents of the granite, such as magnetite, molybdenite, monazite, and euxenite. The tin is recovered by using hydraulic monitors and washing the gravels. Towards the east the granites are covered by the young, almost horizontal, sedimentary beds of Karroo strata which form the low veld. These sandstones, slates, and coal-measures are approximately the same age as our Upper Carboniferous and Triassic beds. They in turn are overlain towards the east by amygdaloidal basalts. The coal found is mainly anthracitic. Because of its character and the lack of transport development has been hindered. The Lebombo hills consist of young acidic lavas poured out through fissures in Post-Karroo (Cretaceous) times.

Thus it may be seen that both old and young sedimentary and intrusive

rocks occur within Swaziland. While it is the ancient stratified rocks which build the highest country in the west, to the east the most prominent relief results from the new intrusive rocks.

The climate of Swaziland is for the most part delightful, and outside the low veld, where malaria is still endemic, European settlement is possible. The hottest months are from September to January, while the coolest period occurs between May and August, and is accompanied by severe frosts on the high veld and along many of the middle veld valleys. The rainfall is seasonal, 80–90 per cent. falling during the hot season and being greatest in the north-west, where it varies from 40 to 75 inches (Map 3). The climate of the low veld is almost tropical, with a rainfall of 18–25 inches. Unfortunately the rainfall is not spread evenly through the hot season, but tends to occur in heavy deluges with considerable spells of intervening dry weather. These short-lived downpours are of relatively little value since the water, instead of sinking into the earth, is at once carried away by streams. The result of this, coupled with evaporation, is that a fall of rain confers on the low veld only about half the benefit it would give to the land of a temperate area. Except in the case of storms the clouds generally blow up from the south-east, and the annual rainfall over the Lebombo is from 30 to 40 inches. The clouds are diverted upwards by these hills, and passing high over the dry bush veld are caught once more against the western mountains. The rivers may therefore come down in spate from the mountains while the low veld is rainless, with an atmosphere heavy and enervating. Vegetation is closely correlated with topography. The high country in the west is grassland and forms excellent sheep-grazing country. Trees and bushes are rare except on the hilltops, where one finds species of protea; or along the more sheltered, well-watered valleys. The grass forms a continuous cover never much above 3 feet in height, while many herbaceous plants, especially aloes, are associated with it. In the valleys, where mists are common, one finds tree-ferns. The middle veld is also grassland, but here the grass is higher and covers the rolling country almost exclusively. One finds bushes, mainly various species of acacias and wild figs, only on the kopjes where bare rock outcrops. Across the low veld thorn trees and bush are the dominant associations. There is a moderate growth of grass below and among the trees, but it seldom forms a continuous cover over the soil. The tree vegetation of the low veld at the present time consists of secondary forest. It is the stunted fireproof growth which after a time springs up on the ruins of old high primary forest and in progressively arid country may be intermediate between the latter and treeless, barren desert. This bush growth is not really attractive in appearance. It consists mainly of deciduous trees, seldom exceeding a height of 20 feet and even when in full leaf possessing no wealth of foliage. Dotted about where soil and moisture are favourable there are indeed groups of much larger trees, often evergreens and of impressive appearance, but they are rare. Acacias and euphorbias are the common species of wood; but there are a few trees whose timber is of economic importance. The slopes of the Lebombo are grass-covered and scattered bushes occur. One of the notable features of the vegetation is the development of cycads on the hilltops.

Within this small country therefore we have considerable variety in topo-

Cotton on the low veld: middle veld hills in the background

Makonjwa range, N.W. Swaziland

Flume carrying water from above Montana Falls to the McCreedy tin workings

Drift on the Lomati river, N. Swaziland

Pawpaws and pineapples in irrigated country near the Pongola river

Pegmatite vein through old granite, washed for tin and abandoned

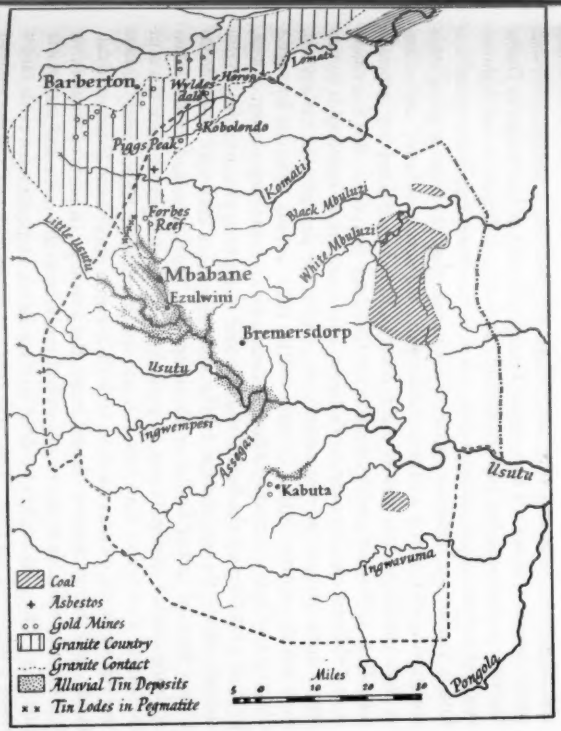
graphy, geology, climate, and vegetation. To what extent this diversity has affected the lives and occupations of the inhabitants must be our next consideration. There are only a few facts on which to base the history of the Swazis. Reports of early Portuguese settlers on the Zambezi and east coast, and the tradition of a northern origin among many of the South African tribes, seem to indicate that at about the end of the sixteenth century there was a southward migration of a large number of Bantu. Judging by the close resemblance existing to-day, both in language and customs, it is reasonable to suppose that most of the tribes of the south-east littoral have sprung from a common stock from which the Amangwane, or Swazis, whose language is simply a Zulu dialect, are also descended. Early records concerning the movements of the Swazis are somewhat confusing. It would appear that they travelled northward from the region of Zululand about the beginning of the nineteenth century under their chief, Sobhuza I. When Sobhuza died in 1839 his son Mswazi found himself the chief of a region stretching from Barberton in the north to the Pongola River in the south, and from Carolina in the west to the Lebombo in the east. During his reign the Swazi *impis* raided farther afield through the Lydenburg and Zoutpansberg districts, and considered these territories as tributary to Swaziland. During the latter part of his reign Boers and other Europeans began to come into Mswazi's country to hunt the abundant game. Some years before his death Mswazi sold the Lydenburg district to the Boers. He probably considered the ceded territory as mere raiding ground and was glad to receive a price for it. In 1855 another grant was made to the Lydenburg Republic. The specifications of the area included in the concession were, "from the lowest poort of the Komati, eastwards to the boundary of Portuguese East Africa. From the poort up along the mountains westward to the source of the Convoemba. From there eastwards to the Lebombos and south-west to the Pongola on Panda's boundary." This description is somewhat vague, but would seem to indicate the whole of Swaziland, and on the terms of this concession is sometimes based the claim of the Union to Swaziland to-day. When the Transvaal came under British rule in 1877 the position of Swaziland was regulated, and the "independence of the Swazis was recognized within the boundary line of Swaziland as indicated." While the cession of his country by Mswazi was not recognized, its effect was to curtail the extent of it in the north and south. Had it not been for that document the northern boundary would have been the Crocodile river and the southern the Pongola river. The eastern boundary had previously been settled with the Portuguese as far south as the Usutu river. Beyond this it was finally fixed by an annexation to Zululand in 1875 of all lands between Zululand and the Portuguese border and the Lebombo and the sea. In the same year Mbandine was proclaimed chief. It is to his love of gin and greyhounds that the Swazis owe the fact that they own only one-third of the total area of their country to-day. The country had long been regarded by the farmers of the Transvaal as excellent sheep-grazing land in winter, and soon after his accession Mbandine granted several concessions to sheep farmers for winter grazing in the mountains.

In 1882 came the Barberton gold rush, and with it the discovery of gold in the Forbes Reef and Piggs Peak district. Several mineral concessions were

granted which in many cases overlapped the grazing rights of the sheep farmers. By the end of his reign Mbandine had disposed of his country not once, but many times. It was to bring some order to this chaotic state of affairs that a Commission was appointed after the Boer War. As a result of the recommendations of this Commission one-third of each European Concession was returned to the Swazis. In the selection of these native reserves every effort was made to avoid moving the kraals and to secure to the natives a fair proportion of the better land. The thirty-one native areas which were established were more or less evenly scattered throughout the high, middle, and low veld (Map 6). One feels a certain amount of doubt as to whether this was in fact a very far-sighted policy for several reasons. In the first place, the Swazis are mainly herdsmen, and when they do practise agriculture it is of the shifting type. This means that the kraal, or native village, is not a stable element in their community life, but may be moved constantly. The Swazis are not immune from malaria, and so they prefer to live in the hill country rather than in the low veld. In many cases only a few natives live in their reserves in the low veld, while the majority are found in the middle veld hills. Europeans could develop the low veld if reasonable precautions were taken against malaria. The risks of that disease would diminish, and eventually with the clearing of the bush the disease itself might be exterminated. Thus a rearrangement of native and European areas which gave more land to natives in the hills and which encouraged European enterprise in the low veld might very well result in a more profitable development of the resources of the territory (Map 4).

Some of the problems of Swaziland arise from the maladjustment between population and land and the distribution of the respective native and European areas. The area in possession of Europeans is controlled by some five hundred landowners, of whom 40 per cent. are habitually absent from the territory. The density of population in native areas is treble that in European areas, being about thirty-eight persons to the square mile.

The Swazis are herdsmen and keep large numbers of cattle, sheep, and goats. Since most of the kraals are found in the middle veld, the largest herds are in those reserves. These middle veld native areas are therefore overstocked and overgrazed so that the stock has deteriorated and the soil has been eroded away. Such soil erosion must be checked in a sub-tropical country or it will have devastating effects upon future economic development. In the high veld also soil erosion has started as a result of the tin-washing, and huge dongas are formed, while countless tons of soil are removed. The Royal Swazi kraal lies at the eastern end of the M'dimba mountains, near Bremersdorp, and it is here that the Paramount Chief, Sobhuza II, holds his court. The kraal of the Queen Mother, Lobotsebeni, lies in the Ezulweni valley. These kraals are built of beehive-shaped huts and surrounded by a fence of dead thorn trees. The Swazis have kept much of the tribal system intact despite the fact that about six thousand go up to the Rand mines every year; and their seasonal ceremonies, such as the Ingwala or "first fruits" ceremony, are of great importance. Throughout South Africa the chief of the Swazis has always been famous as a rain-maker, and this superstition still holds to-day. The Swazi is a well-built, athletic type of native and, like the Zulu, a keen fighter. He is a courteous, cheerful person, but, according to the


Barberton
Wylde-dale
Harry
Lomati
Kobolondo
Piggs Peak
Komati
Forbes Reef
Black Mbuluzi
White Mbuluzi
Little Usutu
Mbabane
Ezulwini
Bremersdorp
Usutu
Ingwempesi
Assegai
Kabuta
Usutu
Ingwavuma
Pongola
Coal
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Granite Country
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Alluvial Tin Deposits
Tin Lodes in Pegmatite
Miles
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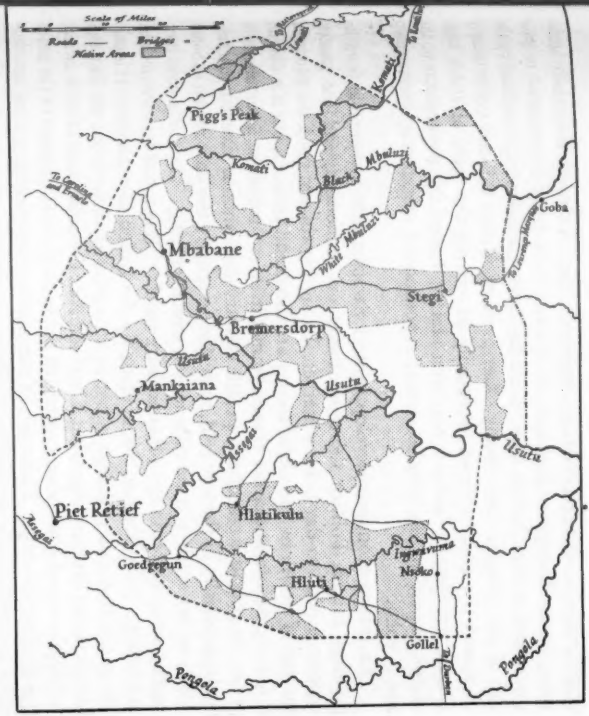
Map 5


Scale of Miles
Roads
Bridges
Native Areas
Pigg's Peak
Komati
Mbuluzi
Black
White Mbuluzi
Goba
Mbabane
Stegi
Bremersdorp
Usutu
Mankaiana
Assegai
Piet Retief
Hlatikulu
Goedgegun
Ingwavuma
Nsoko
Hluti
Golle
Pongola

Map 6

standards of a white civilization, extremely lazy. Although essentially herdsmen, under European guidance the Swazis have been encouraged to grow maize and millet. Native agriculture has been considerably modified by the use of the plough. As in many other parts of Africa, this has unfortunately increased the area, without necessarily improving the yield of arable land. Cotton growing by natives has been started under the supervision of the cotton expert at the Empire cotton experimental stations at Bremersdorp and N'soko.

The future economic development of Swaziland is inseparable from its political future. Politics there are based on economics, and the greatest economic need to-day is for a market. Excluding tin and gold, the two main sources of wealth in Swaziland to-day are cattle and tobacco, but it is difficult if not impossible to market these commodities at present at a remunerative price. Swaziland is essentially a cattle country and contains excellent ranching lands, especially in the low veld, which is practically the only region in South Africa where cattle can be fattened on winter grazing. The cattle have been eagerly sought after in the Johannesburg market. When this fact was realized an embargo was placed on Swazi cattle by the Union Government. It is only fair to say that this embargo is not so stringent as that placed on Southern Rhodesia and Bechuanaland, but it has increased the difficulties of cattle owners in Swaziland and has also strengthened the natural unwillingness of the native to part with his cattle. The result of the embargo has been a gradual accumulation of scrub-cattle within the territory, aggravating the question of overgrazing and increasing the difficulties of water-supply. The pure-bred cattle of Swaziland are small animals. The embargo is one of weight; no animal weighing less than 800 lb. may be exported into the Union. In some cases old large oxen worn out with the plough will pass the embargo, while small prime beasts will not. These latter have to be sold at low prices to Durban freezing companies for export abroad. It is not difficult to sell high-class stock at prices which, though low, are remunerative, but it is impossible to find a market for ordinary cattle. This means that the best breeding stocks are passing out of the country while only the scrub remain, and so long as this continues the cattle must deteriorate. An obvious but expensive remedy is to import pedigree cattle for breeding purposes. But this remedy is not without disadvantages. Pedigree cattle are more susceptible to tick-borne diseases, such as east-coast fever, which are prevalent in the low veld, than are the native cattle. Control of the ticks is only obtained by regular dipping and hand-dressing, which necessitates an enormous amount of work, both in rounding up the herds of cattle and in dipping and attending to each animal. Since the imposition of the embargo stock can only pass into the Union through either Gollel or Komatipoort. Stock destined for the Johannesburg market generally has to pass through Komatipoort, since this is on the direct Lourenço Marques–Johannesburg railway. Hence many farmers and native stock owners have to trek their cattle enormous distances to railheads, and pedigree stock cannot stand the journey. In parts of South Africa it is found profitable to feed agricultural produce to the cattle and market it in this way. This also cannot be done in Swaziland, since stall-fed cattle cannot stand a long trek on foot. The time taken to reach railhead and the enforced

quarantine period for the cattle there not only reduces the quality of the animal, but makes it impossible for the farmer to take advantage of fluctuations on the market. All these difficulties face the cattle farmer in Swaziland. In 1930 it was estimated that 10 per cent. of the animals would not pass the embargo: in 1935 this number had risen to 90 per cent.

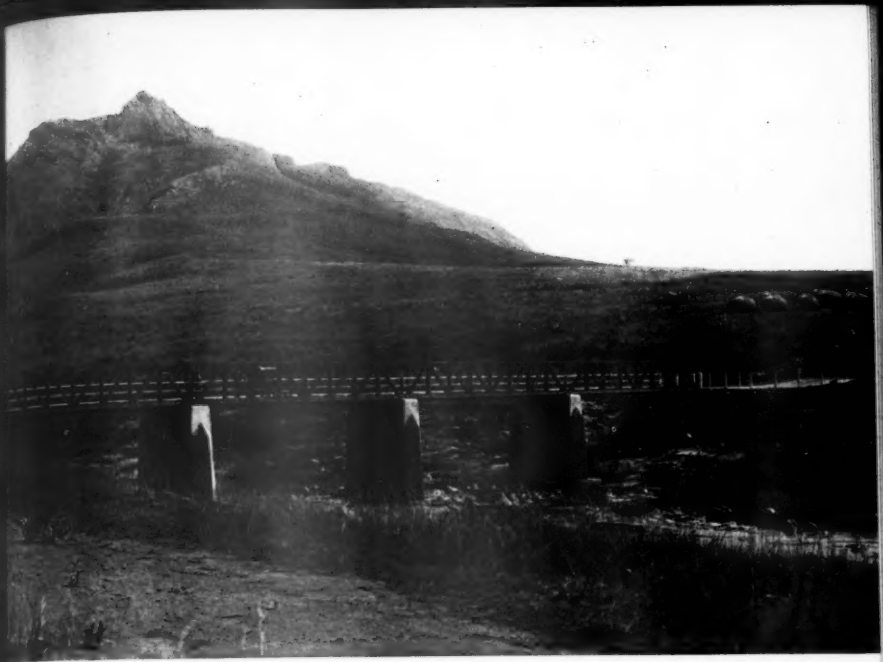
Tobacco growers in Swaziland also feel that they have been placed at a disadvantage in competing with the Transvaal producers. Until 1930 they were free to market their produce individually. At that date, much against their will, the Swaziland growers formed a co-operative society as the only alternative to an embargo. It was announced that the Union Government wished to place the Swaziland producers on an equal basis with the Union producers, who were being formed into co-operative societies in the different areas. Now, in 1935, the Barberton district, which produces twice as much tobacco as Swaziland, and being its near neighbour is its biggest competitor, is still a free area, while 25 per cent. of the Union tobacco is still produced from areas where co-operative selling is not in force. Tobacco in Swaziland is grown throughout the south in the middle veld, on the grey granite soils where these are light but not too sandy. It is all dark tobacco, 35 per cent. snuff and the remainder pipe. So far, very little flue-cure tobacco has been grown. Production before and since the introduction of the co-operative society is interesting. In the year 1929–30 there were 1,680,000 lb. produced, while in 1933–34 the pool was 274,000 lb. In the high veld of Swaziland the economic development is, of necessity, different from that of the middle veld. Here sheep rearing is important, and many Transvaal farmers who have obtained grazing concessions trek into the country at the beginning of the cold dry season. The prevalent mountain mists of the summer which are a contributary factor in the production of good pasture land are also particularly favourable to the growth of wattles. Both eucalyptus and black wattle plantations have been started. The bark of the trees is of commercial value. Here again the Swaziland growers are at a disadvantage, for neighbouring producers in the Union are granted a government subsidy. A crop introduced fairly recently into Swaziland is cotton which for some time was very successful. The alluvial soils of late tertiary volcanic origin in the low veld and some of the lighter soils of the middle veld form good cotton soils. The variable nature of the rainfall in the last few years has prevented many farmers from planting the crop. Mixed farming is carried on in the middle veld with citrus, tobacco, soya beans, and pecan nuts as important crops. On the Lebombo, where patches of very rich soil occur, maize grows well. The development of tung oil trees in the district is interesting, and is proving successful. Its future lies in the possibilities of developing other oil-producing crops in greater quantities. These would be sunflowers, cotton, and soya. With an increased proportion of oil-producing crops it might be possible to establish an oil factory in the territory.

The low veld is the area which would appear to possess the greatest potential agricultural value. With the bush cleared, irrigation schemes and transport facilities supplied, the low veld should develop as an important plantation district. The citrus plantations of the southern middle veld could be continued eastward. These already produce grapefruit, oranges, lemons, and

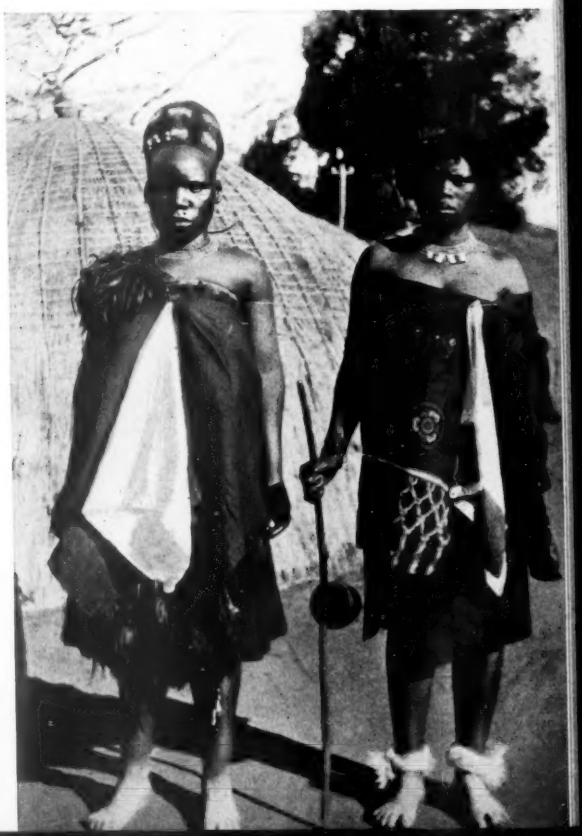
leichies of good quality, and since the season in Swaziland is an early one, some fruit already fetches a high price on the London market. Not only citrus, but such sub-tropical fruits as bananas, pineapples, paw-paws, avocado pears, and mangoes would do well in the low veld; while it is considered that the country is suited to large-scale cotton and sisal production. Investigations have shown that the soil is good and in most places would respond to irrigation. From surveys which have been made for the irrigation of certain areas it appears that the dams would not suffer from being silted up, as has occurred elsewhere in South Africa; though here, as in other areas, it may be found that irrigation will accelerate the development of alkaline pans just below the surface which render the soil infertile. It would be possible to build comparatively inexpensive schemes on all the rivers. An irrigation scheme has just been completed on the Pongola river south of the Swaziland border. Crops cultivated on land from which the bush has been cleared are giving excellent results and the progress of this scheme may give Swaziland an idea of what might be accomplished in her low veld.

Until communications are improved development in the country will be retarded (Map 6). Roads within the territory are good during the dry season. Since there are few bridges over the rivers most roads are closed during the wet season, because the drifts become impassable when the rivers rise. Railways, though built up to the border in the south at Gollel and on the Portuguese border to Goba, do not traverse the country, and the other three railheads are Komatipoort, 40 miles from the northern border, and Breyten and Piet Retief, 50 and 20 miles respectively from the western boundary. Goods are carried to and from the railheads at Breyten, Piet Retief, and Gollel by the Motor Transport Services of the South African Railways Administration, inaugurated in 1928. The benefits derived from the introduction of these services have been very marked: the isolation of the territory has been removed and the costs of exporting commodities such as cotton and cream considerably reduced. The construction of a railway would greatly reduce the cost of transport, more especially of bulky products. So long as the main market of Swaziland lies in the Union, any railway constructed in the territory must be either a branch line to the Union main lines or part of a Union line of through communication. Four prospective lines through the country have been surveyed, but present economic conditions are such as to prohibit any railway development in the immediate future, and the territory must for the present depend on the expansion of motor services or on the development of some other means of transport of a more economical character which would reduce costs to a level comparable with those of a railway.

Of the five towns of Swaziland, M'babane, Mankiana, and Hlatikulu are all situated on the edge of the high veld, Bremersdorp lies in the middle veld, and Stegi is built on the summit of the Lebombos. The town of M'babane is the administrative centre and capital, with a population of about three hundred Europeans, but the greater proportion of both the black and white populations lives in the south, in the district around Hlatikulu. The High Commissioner for the South African Protectorates resides at Pretoria and only goes on tour through the territories at intervals. The chief of Administrative Affairs in Swaziland is the Resident Commissioner in M'babane. The application of



Bridge over the Little Usutu, east of Mbabane: kraal-huts on the right



i women with their hair dressed in e fashions

Bush-covered low veld: Lebombo Hills in the background

Aerial view of the high veld: Black Wattles in the foreground

Grape-fruit and orange trees on a middle veld farm

the ordinary system of Colonial Administration to such a small unit has necessitated the division of the country into several districts, each with an Assistant Commissioner in charge and possibly Assistant Deputy-Commissioners. This arrangement makes administrative expenditure in Swaziland high.

This brief survey of economic conditions may serve to show that Swaziland has definite possibilities for future development. At present, lack of communications and the uncertainty of the future of the territory, coupled with insecure markets and the difficulties caused for the farmers by restrictions tend to make capital shun the territory and to discourage settlers. The Commission sent out by the Imperial Government in 1932 to inquire into the economic and financial situation of Swaziland sums up the necessities for development as follows: " For Europeans the main requirements have been found to be improvements in transport and continued assistance from the Colonial development scheme for productive improvements. For the Swazis, improvements in methods of cattle breeding and cultivation are suggested. These should be accompanied by such extensions of education and of medical facilities as are necessary to the fulfilment of the obligations of an enlightened Administration." Are these the immediate requirements of this Protectorate, which is—to quote again from the Report—"an island in a foreign territory which is dependent on the Union for markets and is therefore economically a part of the Union" ? It is also pointed out in the Report that "cattle are the main wealth of the natives, whose interests are inextricably combined with the interests of Europeans." Swaziland needs not something which may take years to obtain, but something of immediate use, and that is an assured market. Given that, the rest may follow. Without it, enterprise will not develop; both natives and Europeans must suffer; new settlements and capital will pass by the territory. It is obvious that the primary producer cannot produce revenue for himself or for the state if he is unable to sell.

The poor white problem in Swaziland, which is mainly confined to the Dutch element in the south, is thus the direct result of uncertainties and insecurities and the paralysing conditions in which farming is carried on to-day, rather than the result of the limited and unprogressive outlook, or lack of initiative of the people, as the Report suggests. The export trade in cattle, the main wealth of Swaziland, has partially collapsed, and with it agricultural advance has been checked and the spirit of enterprise repressed. Internal trade, too, has all but collapsed for these same reasons, restrictions and embargoes. It is thus the question of markets which dominates the whole financial and economic situation in the territory and causes distrust and unrest among both black and white populations. Only with the knowledge that her markets are secure can Swaziland hope to utilize to their full extent those geographical advantages which are hers, whether she is a Protectorate or an integral part of the Union of South Africa.

THE NEW HEBRIDES PEOPLE AND CULTURE

T. H. HARRISSON

THE New Hebrides and Banks Islands natives have not been described as a unit, and our knowledge of south-central islands culture is still practically nil. The north and south parts of the group have matrilineal descent, but in the centre descent is patrilineal, this being almost certainly the later evolved form. The patrilineal people have two regular characteristics: slit gongs placed upright and a skull cult. The penis wrapper and incision are patrilineal and southern matrilineal, but do not occur in the northern matrilineal section, where the men wear hanging mats or go naked. Female clothing has a typically complex distribution; in the Banks a narrow *tapa* strip, in Santo a tiny leaf strip, in the north-eastern and central islands a red mat, in north Malekula a fringed mat, central Malekula fibrous skirt, south Malekula a plain mat, the southernmost isles a large fibre skirt, very elaborate on Erromango (Humphreys, 1927).

Secret societies have a wide distribution, but the secular graded society (*Sukwe* or *Maki*), the principle feature of life in north and centre, is absent in the south. Stone work is used in connection with this society except in north-east Santo. Hereditary chieftainship dominates the southern isles, but in the north only occurs among the Big Nambas. Remarkable are the long-headed deformation people of south Malekula, with a most elaborate secret-society culture. Totemism has a most erratic distribution, as has the use of *kava*. The most southerly islands have dominantly curvilinear art, but in the north angularity is regular. A benign ancestor-creator, with obvious affinities to Polynesian Tangaroa, is universal and of probably later origin *via* Omba and Malo, while Maui, the earlier Polynesian deity, is confined to the southern islands (*cf.* Williamson, 1924). The importance of the colour red and a rank society for women have a correlated distribution in the north-east and north-centre; splendid pantomimic dances, *na-leng*, the highest manifestation of native art, have a similar distribution, but occur again in simpler form in the southern isles. These too are later influences, as also a form of sacrifice on a stone table. The exact nature and effect of the many haphazard and subsidiary distributions of ideas that have occurred in these islands are being studied by Layard and myself.

The local variation and complexity of this culture is astonishing. There is apparently no single item which is found uniformly throughout the group. Some things have a wide distribution, such as the word-root *mal* connected with the hawk, megapode, and rituals in which these are concerned; a many-barbed spear of casuarina wood; the term for child *natuk;* the ritual importance of tusker pigs; pandean pipes, though these vary greatly in form and usage. Of special interest as culturally peculiar are the Sakaus, with the simplest culture in the area; the communal house hill people of Santo; the Big Nambas and fibre-skirt tribes of Malekula. I am unable to decide which, if any, of these is the earliest and most truly Melanesian form. Our whole attitude to this problem must be revised before knowledge can advance.

Within the tribe the shape, architecture, and type of house built is constant,

Pygmoid people from central South Malekula

Middle Nambas of North Malekula

Tomman Island canoe and long-headed men

Clearing for a garden in South Malekula

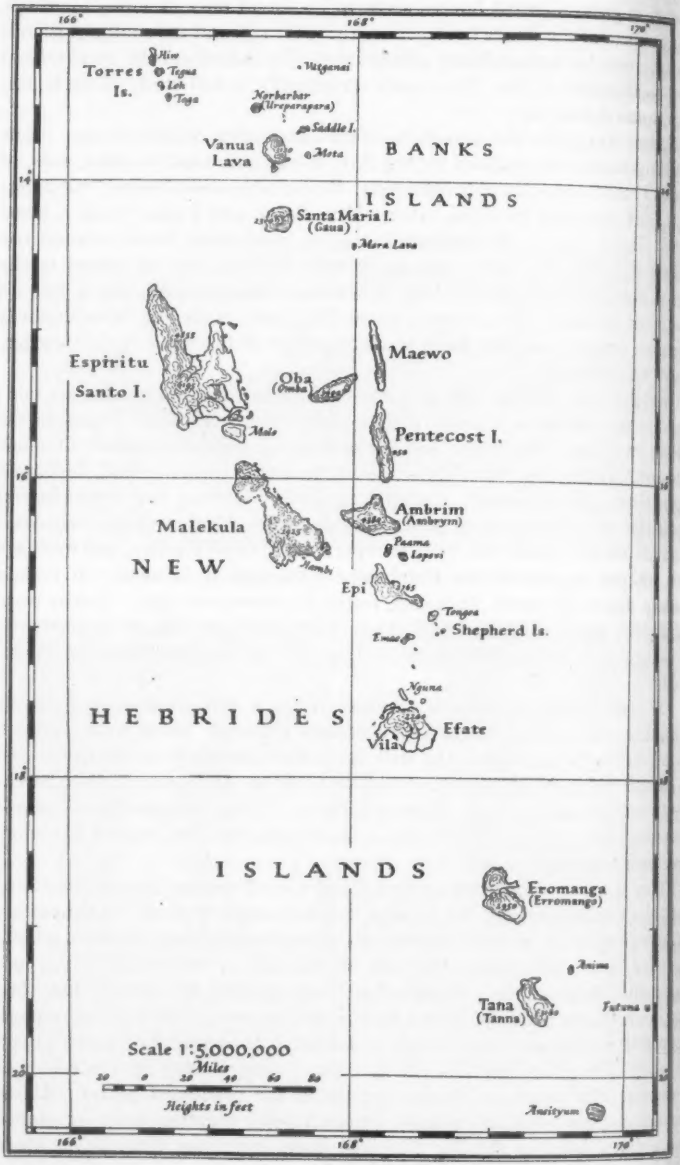
but there is a big range of inter-tribal difference; take several islands and the variety is great. Curved houses seem to be found only in south Malekula, Ureparapara of the Banks (*cf.* Speiser, 1913, Pl. 15), and the southern islands of the group, an extraordinary distribution. To understand the development and organization of the village only structurally, a full study of each particular unit is necessary.

Speiser (1913) has said something of the distribution of stone works. Stone pudding-basins are confined to Big Bay. I was interested in stone axes, of which I made a considerable collection. Remarkable stone basins, "witching-vats," are confined to Gaua, where Mrs. Baker and I also found a stone effigy (Baker, 1935). In one small area of south-west Santo, around the village of Tavua, the stone axes are entirely distinct from all others in the group, being very slender and long in relation to their breadth. Shell axes do not occur in Santo, but are common in Malekula; in the Big Nambas there are some ritual clubs that seem to be made out of fossilized squid's cuttles, very long and heavy.

War-clubs are curved only in north-east Santo; long stick clubs are confined to the northern islands; paddle clubs characteristic of Malekula are absent on Santo. The Santo and Malo bows are regularly arched; in south and east Malekula the concavity is uneven, greater in the lower half. Feathered spear shafts are apparently confined to north Malekula and islets; fearful spear-tips of serried human bones only in Santo. Feather-shafted arrows I have not seen in Santo, but Speiser reports them from Big Bay, and there are two without locality in the Cambridge Ethnological Museum; in certain *na-leng* dances of north Malekula, feathered arrows are used. Combs worn in the hair show wide pattern range; a triangular form I have only seen on Gaua, and ones with handles decorated by pigs' bristles are confined to Sakau, Santo.

The distribution of *kava* is curious. It has a very local usage in north Malekula, where it is chewed and spat into a trough; is not used in south Malekula; in Sakau, Santo, the stalk is chewed; elsewhere in Santo the root is chewed and spat out into coconut shells (only by chiefs in part of the north-west), except around Turi, where it is absent. In the eastern islands *kava* is generally used green, crushed with a stone pounder. On Malo it is seldom used unless in magical rites.

There is a fair uniformity in the type of mixed bisexual dances connected with the graded society; the musical instruments vary more. Pan-pipes are the most important in north-west Santo; though widespread, these are seldom used for dances elsewhere; they are semi-sacred in central Malekula; into Sakau and Malekula the pan-pipes have been recently introduced. On Malo and in east Santo bamboos beaten on the ground are the main dance accompaniment; the former type is close to a large flute figured by Speiser (1913, Pl. 108). The nose-flute is used in Sakau; musical bow in central-south Malekula. Slit gongs are always upright in the patrilineal central islands, reclined in the northern islands. Sticks tapped together have developed into a dance band in the Big Nambas. Bone knives are common in south Malekula, but nowhere else have I found one; wooden knives are absent in Malekula, crude in Malo and W. Santo, elaborate in the Banks Islands.


166°
168°
170°
Torres Is.
Hiw
Tegua
Loh
Toga
Vetganai
Norbarbar (Ureparapara)
Saddle I.
Vanua Lava
Mota
BANKS
ISLANDS
14°
Santa Maria I. (Gaua)
Mera Lava
Espiritu Santo I.
Oba (Omba)
Maewo
Pentecost I.
Malo
16°
Malekula
Ambrim (Ambrym)
Paama
Lopevi
NEW
Epi
Tongoa
Shepherd Is.
Emae
Nguna
HEBRIDES
Vila
Efate
18°
ISLANDS
Eromanga (Erromango)
Aniwa
Tana (Tanna)
Futuna
Scale 1:5,000,000
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20 0 20 40 60 80
Heights in feet
Aneityum
166°
168°
170°

Tattoo is elaborately humanistic in the Banks Islands; simpler on Pentecost, with occasional spirals and circles; intricately angular on Omba; on Santo simple geometric patterns, almost entirely non-representative. Scarification replaces tattoo in Sakau. On Malekula I have not seen tattoo.

I found that chance, individuality, error, misinterpretation, war, and wind were most important in determining the cultures I investigated; these are allowed no place anywhere in Rivers' 'History of Melanesian Society' (1914). I have also much evidence for the spread of ideas and objects ahead or independent of the people who originally brought them, often accidentally, to one point. There is little evidence to be found for logical coherent waves of the Riversian "*kava* people" type into this part of Melanesia. And whereas movements have generally been considered to pass from the north southwards, there is no doubt that the two most obvious diffusions which I have been able to trace spread westward from Omba, which was almost certainly effected from the east, and northward from Efate through Emae, Tongoa, Hambi to south Malekula; important culture traits in Santo have largely been derived from Malo to the south. After studying the literature and the people themselves, I have come to the conclusion that the culture of south Melanesia is even more complex than had previously been supposed. Far more data are needed to make any broad generalizations valuable. There are still whole islands about whose culture we know nothing. The forthcoming work of Layard, and to a lesser extent my own, will I think demonstrate that some of the north Malekulan and Atchin traits can be associated with ritual or belief all over the Pacific and in much remoter parts of the world. These islands seem to have received the last flickers and backwashes from every step in world evolution: that is true for the period of white influence too.

Present position in the Group

The white is in general disliked by the native: mission natives sometimes like their missionaries. What respect black has for white is founded on what the former calls the latter's "cleverness"—the things he can make, his tinned sardines and launch engines. Among many peoples now, especially on Omba, Efate, Tongoa, and Nguna, there is a dawning determination to have some say in their own affairs. Now the natives have no control of any sort; they know they are being underpaid or misused. Their lack of unity has been and is the main obstacle to reform. Land in particular will be a future problem. On some islands the French claim more land than there is above water; they vigorously curtail the expansion of the native in every direction, and notably on Aore and Malo have driven out whole villages. Among the bushmen anti-white feeling is generally strong but passive; for here there is little concern with the small world outside. And whereas the bushmen are without exception decreasing, the coastal peoples in many parts, and invariably when close to a missionary and his medicines, are increasing.

On the basis of a very detailed study (to be published elsewhere) I am convinced that a hundred and fifty years ago there were not less than one million natives in the group; there are now about forty-five thousand. "Civilization' has crept on, though perhaps more slowly than anywhere else in the world. It is the missionary and the germ that has made the coast safe for civilization.

From the first missionary, John Williams, murdered in 1839, until the present day, these devoted men, working according to their own lights, meeting often with sudden death, have been the only influence for good and sanity of any sort; even had they accomplished nothing, the missionaries would be the best people in island history. It was not always the Mission who converted the people or disrupted the native civilization. It was the chaos of endless new unknown diseases, the fundamental cultural upset due to iron and firearms. In seeking protection from these and from the other whites who brought them, the natives came to the missionary. The early records of the group are a ghastly list of introduced diseases—scarlet fever, measles, consumption, smallpox, phthisis, gonorrhoea, whooping cough, influenza, diphtheria, meningitis—all fatal to these people. The population, particularly where it was much in contact with whites, was decimated. Their culture was based on a certain speed, rhythm, and age-cycle; the sudden death of artist, magician, or chief upset the whole. The old beliefs, ancient gods, counter-magics, and native herbs, could do nothing; so they turned to the white man's god, who must be stronger than their own. The new trend among the missionized people, as it gathers internal momentum, shows signs of turning against its instigators, the white missionaries. So far experiments in founding a native-run church have regularly failed. The new motive power is economic rather than religious; some revival of passive heathenism is an ingredient. The price of copra, regulated by the combines far away in Europe, has become in many ways the determining factor. During the period of my visit copra prices reached their lowest level. The missionized natives have become dependent on their coconuts to earn them money for knives, calico, tobacco, belts, even bread, rice, and tinned meat—the substitutes for "heathen" things that have become extinct through mission influence. Low prices mean little money and a standard of living reduced below the level of the last thirty years, in many ways below that of the heathen bushmen. This annoys the native against the white, who has created these demands and will not satisfy them; and a shirt has become the essential symbol of a mission native, to such an extent that without a shirt he feels no longer Christian. I doubt if the group has within sight an important economic future for the white man, despite the recent optimistic accounts of Archimbaud (1927) and Lop (1933). The Chinese and Japanese are rapidly gaining economic power; they may find in these fever- and cyclone-ridden islands an important outlet. Half-castes are not numerous. French ones rank equal with pure Frenchmen as citizens, and run many French plantations.

Recently the administration have to some extent changed their policy, for example in relation to trouble within the native community and in appointing me to pacify the Big Nambas. The native will therefore expect more arbitration in future; if it is not provided, the administration will be discredited, to the danger of all whites.

So the age-long cycle goes on. The native population was never stable, either in culture or in numbers. When Quiros came the population was about at a peak in the north; now it has reached a trough, on the interminable up and down of all races. It is time for the Melanesian to climb again. He is climbing wherever conditions are at all favourable. And the vital question

now, to those of us interested in the deeper aspects of human life, is whether the real *bush* Melanesian, still with some awareness of his own magnificent past, will start to climb again before it is too late. I believe that with a little help he too can be saved along with his already secure Christian brother.

Conservation of the Primitive Melanesian

The inland bush people of Santo, Malekula, and to a lesser extent Ambrym and Pentecost, are the least civilized natives in the Pacific to-day. A few places in the Solomons are comparable to some extent, while here and there in Polynesia, for example in the eastern Tuamotus, the old spirit remains under the new clothing. Elsewhere the "South-sea islander" is no longer anything like his old self. All Polynesia has reached the calico stage; in the New Hebrides the calico stage has not touched central Malekula; the stone age is quite finished everywhere. And in the east the boot age is dawning.

What should happen to these least-influenced Big Nambas, Laus, and Botowut folk? What will happen is an easier question. Unless some very vigorous and powerful person takes up the matter at once they will not be primitive any more. They will be extinct culturally through plantation and later-mission influence, when they have been finally reduced to near physical extinction by introduced epidemic diseases. I doubt if anything can check the material superficial advance of our civilization. It may be possible in a well-run country like New Guinea. With the Condominium it is quite impracticable to have any complex plan.

(i) *Physical Conservation.*—The problem has two parts, physical and cultural conservation. That is why I am against isolation, which would now be no use in a part of the world where disease is the first enemy and where incompatible vested interests dominate. I am not in favour of Baker's (*Geogr. J.*, 1929) suggested reserve on Gaua. Gaua is a particularly unsuitable island because the natives are decadent, very missionized, and unhealthy; none of the old culture remains. The trouble is that an island like Gaua is already too isolated; it has all the evils and none of the good things of Europeanism. Even in 1896 Bishop Wilson (1932, p. 91) noted that "these people are akin to the rest of the Banks Islanders, and yet so greatly inferior; it is difficult to say why, and it is the same on both sides of the island." The detailed study made by Mrs. Baker and myself will be published elsewhere, and may explain why.

Similarly the inland tribes on the larger islands cannot be isolated from epidemics spreading up from the coast. If the bushmen were isolated to-day they would go on steadily dying out: not from the lack of the will to live or zest of life (the widely accepted theory first put forward by Rivers), but from definite diagnostic disease. The only way to preserve them as human beings, let alone in their semi-primitive state, is by immediate medical and hygienic action; by perhaps a party of tropical medical men, including native medical practitioners from Fiji. Eucalyptus, neokarsarvin, hookworm medicine, emetine are necessary. Even the wildest natives have heard about the wonderful benefits derived from these drugs. Lepers must be isolated. The administration should do this; partly through lack of funds its medical service does practically nothing; the missionaries do very useful work in a limited sphere,

but they do not attempt to help the heathens, unless the heathens come down to the often unhealthy coast and adopt the externals of Christianity. The Missions do not go to the natives, and in Santo, Malekula, and Malo, out of about six thousand Christians, only thirty live away from the sea. In the hills there is no malaria, consumption, or elephantiasis; when the hill-men come to the sea they quickly go down with fever, and the slightest additional sickness will kill them. Mission history is a ghastly list of great settlements created by the Missions on the coast, and now almost or entirely extinct. Aneityum, west Malekula, and west Santo show plenty of examples. I have already made the point that it is similarly fatal for missions to neglect their converts in outlying districts; this is done all over the group. The recruiters do the same

thing, only in a different way, by taking bush natives to work in plantations; they are more concerned to keep their men well, because if a man dies his tribe will not work for that recruiter any more. Long ago Anthony Trollope wrote a delightful account of the benefits due to Queensland blackbirding; Campbell (1874, p. 69), whose account of the southern isles in 1864 is lucid and unbiased, demonstrated the fallacy in Trollope's reasoning, and further pointed out that ex-plantation natives often become the most dangerous on their return to the bush, which is equally true to-day, especially of trained native police.

In my section of the Big Nambas I have shown that modern warfare, unlike the old form, is socially harmful; all natives should be disarmed; vigorous medical work started and maintained throughout the islands; the fish *Bam-*

fusia introduced to destroy mosquito larvae; the movements of hill people to the sea controlled; no women should be allowed to work on a plantation. If these steps are taken the physical conservation of the bushman may be achieved.

The cultural conservation technique cannot be expressed so concretely. It is too late to preserve the pattern complete. There is however a good alternative, and I can best give my point of view by describing a concrete example of what can happen with proper guidance or good luck, as on the island of Atchin.

(ii) *Atchin*, 1935.—There is no doubt that on small islands a mile or less across health is much better and *Anopheles* mosquitoes are often absent. They are the small island populations which are increasing most rapidly throughout the group, though some are still decreasing, and in these islands I see the best future of the race. Most have mainly mission populations, but on some heathens are dominant. One such is Atchin, half a mile off the east coast of Malekula; of the four hundred and eighty natives less than two dozen are Christians. A Seventh Day Adventist missionary lived there for many years, and all the other missions maintain native teachers there. The missions have had no success, but the natives got some ideas from them which they have incorporated into their own culture. More valuable has proved the visit of an anthropologist, John W. Layard. He was there more than twenty years ago, but to this day is remembered as Tsoni (Johnny). He gained a remarkable understanding of the Atchinese, and his sympathy greatly encouraged the people to keep up their old heathen customs. Like all Hebrideans, the Atchinese sold land to the whites for a few guns in the early days. Unlike all the rest, they have since bought it back. Their country is their own. As their yam gardens are on the mainland, they are expert canoeists; they still keep up the old canoe voyages to Ambrym, trading penis-wrappers for pigs; to Malo, Santo, and east Malekula. The old turmeric-dye leaf trade has been taken over by French ships, and for some years now there has been no ritual sex-initiation voyage to Omba, home of the benign deity Ta-har (=Tagaro). The best fishermen, whole villages club their copra together to get a modern European drag net; but do not let decay the ancient stone-wall trap, a sort of lobster-pot, and the special handnets for the Palolo worm, which at certain seasons appears in millions, giving its name to three of the lunar months. They run their own stores and sell their own copra to the highest bidder of the several ships that call in search of this lucrative trade. They encourage whites to visit but not to stop. They make sham spears to sell to world-touring yachts which call regularly to see these remarkably safe savages; the real spears they do not show. They have twice done all their dances for film companies, in no way to the detriment of the dance culture or significance, rather the opposite. Baker (1935, p. 212) says of the Sakaus, Santo: "If they had been persuaded to dance for the tourists it would have been the beginning of the break-up of their culture, in which dancing plays an important part. . . . The prostitution of their culture by tourists would be deleterious not only to themselves but also to social anthropology." Apart from the fact that the Sakaus have unfortunately lost, almost forgotten, the whole dance-cycle of the highest chiefly grade (*vuster*), and that the special dance for the marriage of a

chief's daughter has been given up for years, Atchin contradicts his theory in fact. Baker I think underestimates the vanity of the native.

The Atchinese are among the very few peoples friendly to the administration, and they now appeal at once for peaceful settlements to all disputes. In the old days they gave a lot of trouble, but living on a small island they found a warship was more significant to them than to the bushmen. War is no more, abortion uncommon; the older men consciously want the place to grow; and grow it does. Thus it was the Atchinese who drew my attention to the exorbitantly high pig payments demanded as bride price all over the area in recent years; with their support I was able to lower the price by 80 per cent., back to pre-white level, thus enabling young men to marry with only normal difficulty. Similarly these folk like European medicines for introduced diseases, but use their own for the endemic ones. Their pig transactions and graded-society (*Maki*) rites have been modified; some things have been taken away, others added, both from white and black sources. Atchin dances are second only to those of Matanavat; they are kept up with exactitude and enthusiasm; also with new and often spontaneous variations in one type of the *na-leng*, the highest manifestation of Hebridean art and living. Sorcery and poison are no longer tolerated; the Atchinese are bitter against the adjacent island Vao for continuing these practices—bitter, but not disbelieving. Magic is not now important; old legends and stories, in which these people excel, are a part of daily life and juvenile instruction; the same myths collected by Layard and myself in 1914 and 1935 respectively agree perfectly, there has been no deterioration. The old burial rites and beliefs survive unimpaired.

In general the old customs that are savage or anti-social under modern conditions have disappeared, while those with business, religious, health, or play value have survived, even expanded. It is in this Europeanized heathenism, this intelligently primitive and adaptive but obstinate outlook, that the ancient Melanesian culture is most likely and able to survive. On Atchin to-day every village has its great drums, in lovely dancing glades, dolmens, carved human and bird effigies; a little distance away behind a native-style stone wall is a cluster of palm houses kept clean; at one corner perhaps a cement and iron house, the men's lodge, pride of the place. The women have more status, charm, freedom, and gaiety than elsewhere in the area.

I found the Atchinese charming people—and charm is a word I seldom think of applying to a Melanesian. They are thoroughly independent and sophisticated, combining Melanesian business ability with a more Polynesian intelligence and grace to direct it. The planters and missionaries have no good word to say for Atchin, which is an indication. Few tribes have had the good luck and intelligence to use the white man's things for their own advantage, in harmony with their own culture. I believe that what the Hebridean needs most to-day is guidance in this direction associated with simple medical aid. New education, religion and outlet are unnecessary and inadvisable now, and perhaps for some time to come. A few sympathetic men and women, without undue prejudice, could with a little money and many medicines work wonders. Atchin might well serve as a model in cultural adaptation. It

is therefore important to place on record the earlier, primitive basis upon which this adaptation has evolved. Mr. Layard has kindly consented to my request to add an account of Atchin conditions at the time of his visit.

BIBLIOGRAPHY

Archimbaud, Léon. 'Océanie Française,' xxx, pp. 58–60. 1927.
Campbell, F. A. 'A Year in the New Hebrides.' Melbourne, 1874.
Baker, J. R. *Geogr. J.*, vol. 73 (1929), pp. 305–25; *Geogr. J.*, vol. 85 (1935), pp. 209–23.
Humphreys. 'The Southern New Hebrides.' Oxford, 1927.
Lop, S. F. 'Les possessions françaises du Pacifique.' Paris, 1933.
Rivers, W. H. 'A History of Melanesian Society.' Cambridge, 1914.
Speiser, Felix. 'Two Years with the Natives of the Western Pacific.' London, 1913.
Williamson, Robert W. 'The Social and Political Systems of Central Polynesia.' Cambridge, 1924.
Wilson, Rt. Rev. Cecil. 'The Wake of the Southern Cross.' London, 1932.

ATCHIN TWENTY YEARS AGO

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ATCHIN[1] is one of a string of five small coral islands, the others being Vao, Wala, Rano, and Uripiv, lying off the north-east coast of Malekula, the inhabitants of which form an ethnic unit and refer to themselves as Sea Folk in contra-distinction to what they term the Bush Folk of the Malekulan mainland. The islands are remarkably uniform, both in size and situation, each covering an area of about half a square mile, and being separated from the mainland by a channel about half a mile wide. Each island supports a population of from four hundred to five hundred varying in physique and in intelligence as much as any average English community, from individuals with comparatively light copper-coloured skin and a degree of intelligence equal at least to that of an intelligent white man, to those of much darker pigmentation and minds approximating more closely to the white man's idea of what he is pleased to call a "savage." Since there is no room for cultivation, the inhabitants of each island own a strip of land on that part of the Malekulan mainland immediately opposite to it, on which they till their gardens. In addition to the communally owned long-distance canoes, in which they sail long distances on trading expeditions, each man possesses a coastal canoe, and the fleet of small canoes sailing or paddling over to the mainland every morning during the agricultural season and returning at night laden with food is one of the most pleasing sights that can be seen in Malekula.

Though forming an ethnic unit, these islands have no central government, nor are there any chiefs such as exist among the Big Nambas of the North Malekulan Plateau. Each of these minute communities (the population of Atchin at the time of my visit numbered 401) has its own language, as distinct from that of its neighbours as any two cognate European languages, and is

[1] With regard to the origin of the word "Atchin," the name given to this island by its own inhabitants is *tsan*, to which, when speaking of it from afar, is prefixed the directional particle *nga*. The work of the Admiralty Survey on these islands is on the whole correct, so that I was puzzled by the considerable divergence in sound between the words *nga-tsan* and Atchin. A second puzzle was presented by the fact that the names given on the Admiralty Chart for the only three Malekulan mountains marked in the vicinity of Atchin were not the names of mountains at all, but the names of villages situated much nearer the coast, in a dialect which differed somewhat both from the Malekulan and from the Atchin pronunciation. Nor did there appear to be any directional relationship between the mountains and the respective villages which were alleged to bear their names. This conundrum remained unsolved till, on visiting the neighbouring island of Wala, I found that in the language spoken there the name for Atchin was *tsin* and the directional particle *a*. From the much closer approximation of the white man's word Atchin to the Wala *a-tsin* it occurred to me that the surveying party, or that section of it which had recorded the name, probably landed on Wala. This supposition was confirmed on finding that the names of the three villages, wrongly used for mountains (viz. Rarab, Batelembe, and Lalembe), were also in the Wala dialect, and that the villages themselves were situated in an approximately direct line between the mountains and Wala. Though I have not looked up the records, it is thus clear that the surveyors, standing on Wala, were given not only the name Atchin, but also, when pointing at the mountains, were given the names, not of the mountains, but of the intervening villages to which the natives thought they were pointing.

possessed of an extremely complex social organization by means of which each island is divided asymmetrically into nameless halves, each rivalling the other and ready at any moment to develop into two hostile groups. In the island of Vao, which preserves the oldest form of social organization in the group, one-half comprises one double village, and the other half two double villages. As with the two halves of the island, so each of the two double villages in the larger half is apt to become hostile to the other, as also is each single village within the unit of the double village. Each single village is further subdivided into two divisions called "Sides of the Stone," which in turn are divided into two family groups, each of which is again subdivided into two smaller family groups.[1] Each village possesses a dancing-ground and central village lodge called *ghamal* where public business is carried on, business concerning individual joint-families being carried on in family lodges called *na-tamp* closely associated with the graves of the ancestral dead. Each of the groups in the progressive bisection of the community is apt to become hostile to its opposing group. On the other hand, each pair of groups combines in ritual activities leading to cohesion, or in the face of a common foe. In every case, whether in matters affecting ritual cooperation or warlike preparation, whether in family affairs or in affairs affecting the whole island, the final decision depends on an informed public opinion led by the older members of the group in conclave. Similar social groupings, modified by a more recent intrusive culture from the Malekulan mainland, obtain in the remaining islands of the group. In all the islands descent is predominantly patrilineal, marriage being regulated along strictly exogamous lines as between patrilineal groups varying in size from the single village to (in the case of Wala) the entire island, as well as matrilineally between relatives tracing common descent extending to three generations backward on the mother's side. Marriages, equally strictly regulated, also occur (and in the island of Wala necessarily do occur) with members of mainland villages and with members of other islands within the ethnic group, whose dialects are known to one another in such a way that every native is acquainted with at least three and often more than three distinct languages.

This complex social organization and linguistic ability presuppose no mean intelligence, and are accompanied by, and intimately bound up with, a genealogical and historical sense unrivalled in Melanesia, to be compared only, so far as the Pacific is concerned, with that of the Polynesians, with whom these people have close cultural connections. On Atchin exact pedigrees, checked by various means, reach back for seventeen generations, and include detailed accounts of the doings of many of the figures appearing in them as well as the ancestry of the various inter-related joint-families which together build up the village organization.

These pedigrees are not only orally preserved. The natives' memories are also kept green by the numerous megalithic monuments which form their most striking memorial. It was the then barely known existence of such monuments, first published by Speiser (1913) that attracted the late

[1] This completely symmetrical arrangement occurs only in the Vao village of Petehul. Organization in the remaining villages has been slightly modified owing to influence from Atchin and elsewhere.

Dr. W. H. R. Rivers and myself to Malekula.[1] These monuments, which include dolmens, monoliths, stone-platforms, cairns, and circles, primarily and to this day still associated with mortuary ritual, reach their highest development in connection with the great sacrificial rite called *Maki*, the name given in these islands to a socio-religious hierarchy corresponding to the Mangke of the Big Nambas, based on identification with the ancestors and with a mythical hawk. This rite is at once the great unifying factor in these islands and at the same time the most frequent cause of the intensest rivalry. In most parts of Malekula the rite is an individual one, performed by one man at a time, and consists of a number of grades which last a life-time in the taking. In Atchin and the neighbouring islands however, owing to their possession of an anomalous kinship system closely allied to the six-class system of relationship discovered by Deacon on Ambrym, it is a communal one, all men of alternate generations within any given village sacrificing at once. The sacrificial animal is the tusked boar, from which the upper canines have been removed in order to allow unimpeded growth to the tusks, which curve round, re-enter the jaw, and, if the boar is allowed to live, finally emerge again and, in rare instances, make three complete circles. The rearing of these boars is an extremely skilled process in which the inhabitants of these islands excel all others, and is accompanied by many magical performances. These boars are graded according to the size of their tusks at any given moment, and also, while alive, serve as currency for the purchase of wives, for ceremonial exchange between affinal relatives, and for innumerable other purposes. It is thus no small indication of the importance of the *Maki* in native life that it is not unusual at the culminating point of one of these protracted rites for as many as five hundred of these valuable tusked boars, each worth from ten to forty pounds in English money, to be sacrificed at once.

There are two kinds, or to borrow an ecclesiastical term, uses, of *Maki* in these islands. In the older form, still practised in the village of Petehul on Vao, there are two monuments only, a large dolmen and a stone-platform, at each of which the sacrifice is made.

In the newer use as practised on Atchin ten shrines are erected along one side of the dancing-ground, each consisting of a dolmen, a monolith, and a carved wooden image representing the ancestral spirit, surmounted by a roof of which the ridge-pole, resting on the head of the image, represents the head and wings of the mythical hawk. By the side of each shrine nine further dolmens or monoliths (depending on which group of alternate generations is performing the rite) are erected, which, joined together, form a continuous line of a hundred stones. Behind all these stand two stone platforms, also furnished with images and roofed, one for each of the two social groups called "Side of the Stone," and on the other side of the dancing-ground is another continuous line of a hundred small stones. These stones all represent ancestors, and it is to them and to the images that the sacrificial boars are tied. The complete *Maki* which, as has been said, is alternately performed by men of alternate generations, is a protracted composite rite lasting, in its extended form, for anything between fifteen and thirty years, during which an almost

[1] Dr. Rivers stayed only eight days, after which he took a passing motor launch to Tangoa.

endless series of minor rites are performed, each involving the sacrifice of numerous tusked boars and an enormous expenditure of food for feasts. Each village performs its own rite in its own time, and the major rites attract guests from all other villages on the island, as well as from other islands and from the Malekulan mainland. There are numerous dance-cycles, frequently lasting all night, and finally, before the supreme sacrifice, for five days and nights on end. Each dance-cycle has its own songs, many of which commemorate the deeds of ancestors, and its peculiar gong-rhythms beaten on an orchestra of upright slit-gongs. Some of the songs are of surpassing beauty, and the gong-rhythms are so complicated that no European has yet been known to master them. Interspersed between the dance-cycles performed at stated intervals throughout the rite are a series of formal square dances and dramatic performances called *na-leng*,[1] many of which have become secularized, but some of which remain traditional and form a running commentary on the mythological background of the rite. This, as I hope to show in a forthcoming work, is none other than a dramatization of the Malekulan version of the journey of the dead, briefly described by me in a recent article (1934), which itself forms part of the mythology of megalithic peoples as far apart as the Nagas in Assam, the inhabitants of the Tamil country of Southern India, peoples of the Near East, of the Mediterranean littoral, and, in our own islands, of ancient Scotland, and in Scandinavia.

The bearers of this megalithic civilization were a maritime and river-loving people or peoples, the details of whose adventurous migrations yet remain to be worked out in detail—there have been at least two separate migrations of them into Malekula—but there can be little doubt that from Scandinavia to Malekula and beyond they have a common origin. One of the greatest interests to us therefore in Malekula is the fact that it is not impossible that, in the ritual of the *Maki* and in the beliefs associated with it, we may see a variant of one aspect at least of what some of our own forefathers, the megalith builders of Britain, did and thought. This rite is also one of fertility and of re-birth, each participant marking his assumption of new life by taking a new name, usually that of a maternal ancestor. The sacrifice of tusked boars is known on Atchin, both by precept and through historical tradition, to be a substitute for former human sacrifice, and those who make the highest sacrifice take oaths to keep the peace for varying periods, extending to three years, or, in the case of old men, a lifetime. Though cannibalism still exists, it is contrary to present *Maki* practice, but its close association with more ancient religious forms is still evident in that when an enemy is wounded, a dolmen, similar to that erected in the older *Maki* use, is hastily constructed in the bush, and the body is placed upon it and there ritually sacrificed, the victor thereupon taking a new name as in the *Maki* proper.

Though the wooden images of ancestors and hawks, and the roofs erected over the stone monuments rot, the stone themselves are never taken down, and remain as a memorial to those who sacrificed at them, whose stones they are henceforth said to be. I have shown elsewhere (1928) that monolith and wooden image combined represent an earlier form in which there was no

[1] See Mr. Harrisson's reference to similar performances among the Big Nambas, p. 332.

wooden image and the monolith itself was carved to represent the ancestral human form, the wooden image having been added only when the art of carving stone was lost, so that what was originally a stone statue became split into two parts, of which the portrait, being of wood, in time disappears, and the plain monolith only remains. Though in Atchin the ritual has become so elaborate as to have largely obscured its original significance, there can be no doubt that in its earlier forms, as still in South-West Bay, the monolith actually represented, and was deemed to be inhabited by, the ghosts of all those ancestors who had previously performed the rite, and, after death, the new sacrificer himself. Hence its importance as a memorial and in the preservation of genealogies and history. Many of the more important figures in Atchin history are thus commemorated, both by their stones and by the preservation of their graves. So strong is the association of ancestors with stones that in semi-mythical accounts they are frequently stated to have had the power to turn themselves into stone during life-time, or to have actually become stone when they died. This process has been carried yet further in the case of those figures associated with the mythology connected with the journey of the dead, who are now to be seen as natural coral blocks standing at various points on the coast along the path trodden by the ghosts of the dead on their way to their future home.

There is no space to do more than mention a few of the most important in the long list of ritual activities in this rich civilization: activities in connection with the belief in ancestors and rites of communion with them; the protracted mortuary ritual; initiation lasting nine months with an intensive period of thirty days in which continuous hoaxes are practised on the luckless novices; the operation of incision; rites connected with the consecration of the long-distance canoes capable of carrying thirty men on trading expeditions to other islands for as far as 80 miles over open sea; a special form of sex initiation performed on the distant island of Omba; the consecration of houses and of tusked boars; magic; their economic life, their fishing, gardening, and trading; their laws of copyright whereby nothing is given, but everything, such as songs, dances, variations in ritual, whole rites, magical formulae, designs for the carving of ancestor-images and of canoe figure-heads, details of house construction and decoration, and a hundred other aspects of their artistically rich culture, is sold by these intensely commercial people at high prices and with due ceremony from individual to individual, village to village, and island to island, thus constituting the framework for the dissemination and blending of endless variations of culture; history and tradition.

One other feature must be mentioned on account of its bearing on the coming of the whites. Mr. Harrisson has already referred to the white-skinned, aquiline-nosed immigrants, who are said to have introduced the latest phases of megalithic culture into that area. On Atchin the equivalent culture-hero is a being called Ta-har, corresponding to the Polynesian Tanggaloa, Banks Islands Tagaro, and the Big Nambas Horo, regarded in Atchin as the benign creator, who is at once a stone and the moon, who made the islands and gave their inhabitants their languages, who arrived in a canoe and introduced the pig and the coconut to ten legendary petromorphic brothers standing on

the shore, and whose name, in spite of his sexual activities which they may not have known about, the missionaries subsequently adopted as a fitting translation for the word God.

(*b*) *Conditions in Atchin in* 1914

In considering the reaction of the people of Atchin to the coming of the white man it will be of use to bear one principle in mind. Anthropological research shows that culture contact, if it be not too uneven by reason of the too great predominance of one party over the other, is one of the prime causes of vitality and progress; that too great stability, on the other hand, almost always leads to decay. Although the nature of the contact between the whites and natives was one of overbearing disparity, and so was not conducive to progress, the situation was remarkably mitigated in Atchin by the existence of culture movements within the native system itself prior to the white man's advent. In the three islands of Vao, Atchin, and Wala, the phenomena both of progress and of decay were thus already at work. Among the many movements of culture occurring in Malekula within comparatively recent times, there arose some eight generations ago a new centre of diffusion at a spot on the Malekulan mainland opposite Wala. The new form of culture spread first to Wala, which, on the subsequent extinction of the mainland villages, became its classic home. Vao still remained the stronghold of the earlier form of culture previously common to all three islands. Atchin was a half-way house between the two, incessantly acquiring new rites from Wala and passing them on, through the slow methods of ceremonial purchase, to Vao. Both Wala, the classic home, and Vao, which at that time was only beginning to adopt the new rites and beliefs, were at the time of my visit comparatively stagnant, and the people of Atchin, being, through the constant changes that were taking place, looser in mind, were at the same time in all ways more progressive. This chance of history has, to my mind, been of no little importance in conditioning the type of reaction on the part of all three islands to the disturbing fact of the arrival of the whites, whom the Atchin people have withstood with much greater success than either of the other islands, and by whom they were consequently both more feared and more respected.

Mr. Harrisson has been good enough to say that a further contributing factor was the timely visit of the anthropologist at a moment of great stress in the history of Atchin, two months after a serious conflict with the government, which, under normal circumstances, might well have led to a punitive expedition. Whether this is the case I am not in a position to judge. It may however be worth stating that I was, so far as I know, at that time the only white man in the group (with the possible exception of Catholic missionaries) who was unarmed and who expressed appreciation for their culture. It would however in my opinion be untrue to say that this attitude of admiration did more than encourage them in a standpoint they had already taken up—a determination that at all hazards they must maintain their own cultural integrity, even to the point of settling their own disputes if possible without warfare in face of common danger.

One of the white man's great complaints against the natives has always been

their quarrelsomeness among themselves. This characteristic is undeniable,[1] but was mitigated before the coming of the white man by the fact that, living in dense bush and being but poor shots with bows and arrows, the amount of life sacrificed in the course of their wars was very small. Wars would drag on for months without a death. With the advent of the shot-gun matters however suddenly changed. What had before been little more than semi-ritual quarrels assumed quite different dimensions, and the coastal peoples, who were the first to obtain firearms, slaughtered their enemies without mercy. The old rule that wars could not cease till the number of dead, rarely more than one or two, was equal on both sides (this alone showing its ritual nature) no longer held when these were multiplied by tens, and war then came to mean the extermination of entire villages. In this way the people of Atchin had themselves assisted in the complete extermination of entire mainland communities, so that where before the white man's arrival there were flourishing villages was now waste bush. In this way almost the entire population of the semi-coastal villages of north-east Malekula, as well as large sections of the population of Atchin itself, had been destroyed, so that the numbers even on this island had been reduced from what are said to have totalled something in the neighbourhood of 1000 to, at the time of my visit, 401. This had made the natives of Atchin think, and their constant cry was, contrary to the opinion of most white men, "How can we combine to save ourselves?"

One method they adopted was, after the expulsion of the last trader, to allow no alcohol on the island. Though passionately fond of drink when they could get it, they had seen enough of its effects and had themselves evolved such a strong public opinion on the subject that no drink was allowed on the island, though it is true that rare passing cutters reaped a brief reward from some of the younger men.

In matters concerning their own culture there was an increasing disapproval of sorcery. How far this was due to the influence of the white man it is difficult to say. It is however a fact that on all the small islands sorcerers, or suspected sorcerers, were finding life considerably less easy than formerly, as the number of refugee sorcerers on Atchin alone showed.

More important, more concrete than these however was their determination to rebuild and reinforce the best elements in their own culture through the performance, ever more magnificently, of the *Maki* rite. One man, almost alone of the decimated Atchin village of Emil Marur, who had spent years on white men's plantations and at the end had been tricked of all his earnings, was busy during the whole of my stay carving the ten images needed for the rite and by intensive garden work and the rearing of pigs and the re-learning of the details of ritual from the older men, preparing for its performance in order to rehabilitate his and his kinsmen's spiritual and, through them, material fortunes. This man was Mari, who, in the clash with the government mentioned above, was in danger of being taken to prison in Vila for an imagined offence.

A similar case was that of Mataru on Vao, this time an erstwhile convert,

[1] The element of fear, though considerable, was never so great in the island populations as among the Big Nambas, owing to the comparative safety afforded by the sea and the greater breadth of outlook gained through trade with other islands.

who had returned to his own people and was busy reviving the fortunes of his village in the same way. These two men were among my best informants, since they themselves were conscious learners from the older men and, like all learners, the most capable of passing on their knowledge.

Nor were the people of Atchin averse to using such aspects of the white man's material culture as would seem to them to further their interests. Though stone tools were still used for gardening and shell tools for carving, some natives possessed knives, but such things were not common, and the degradation in plastic art which everywhere followed on their introduction had, at the time of my visit, only recently begun to show itself. It seemed, by the way, most curious to me that, with the tremendous labour of digging in hard ground with nothing better than hard-wood sticks, no white man had thought of introducing more efficient agricultural implements, but none such existed. The hard-earned white man's money obtained on distant plantations was used almost exclusively with two objects in view. One was the purchase of whaleboats to replace their former long-distance canoes in order to facilitate the trade in and exchange of pigs in other islands. The second, closely connected with it, had as its result the only real benefit conferred by the white man, indirectly and without his knowledge, on the native. When I arrived on Atchin I was surprised at the number of young men who spoke pidgin English. It was not till I had been some time on the island that the reason for this became apparent. One of the least desirable aspects of the social system in this and the neighbouring islands was polygamy which, since most of the older men had two wives, effectually prevented the younger men from marrying until a comparatively late age. Wives are bought with the most valuable currency known in Atchin, namely pigs. So the younger men seized the opportunity created by the system of indentured labour to sign on for three years, without, like other natives, running up debts at the trader's store, so that with the money thus earned they might, on their return, buy pigs with which to purchase wives. This wholly beneficial revolution in the social machinery was in full swing at the time of my visit, but Mr. Harrisson tells me, and this is one of the most interesting points of comparison between then and now, that the old men have now turned tables on the young, and by devaluing the pig in terms of women and increasing the bride-price from eight or nine pigs to fifty or sixty, have thus restored the old equilibrium, and incidentally, presumably, their own authority. When we reflect upon the fact that the young men twenty-two years ago are the older men now we have a useful sidelight on one of the mechanisms governing the rise and fall of revolutions.

Another effect of the increased wealth in pigs thus gained was the elimination of the lower grades from the *Maki* hierarchy. This process was not primarily due to the wealth so gained, but, like so many other changes in native custom, was very much accentuated by it. In all other parts of Malekula the *Maki*, as has already been pointed out, is a graded hierarchy in which the grades are taken by individuals, and the taking of them demands great expenditure of pigs and other forms of wealth, so that when a man has reached the highest grade called *Mal* he is a very great man and jealous of his distinction. The tendency in such districts was consequently to increase the number of pre-

liminary grades in order to enhance the dignity of those few who had reached the highest rank. In Atchin, on the other hand, owing to the communal nature of the rite and the mutual help afforded by every member of the village community to every other member, a contrary process was at work, the lower grades being already in process of elimination before the arrival of the white man. With the acquisition of the new wealth this process became speeded up, with the result that by the time of my visit they had all disappeared, so that each and every man, youth, and male piccaninny on the island who was capable of sacrificing a pig belonged to the grade *Mal*, much to the chagrin of those in other communities who had taken a lifetime achieving it. Even the older men on Atchin felt somewhat abashed by the general levelling-up, and, in order to assert their own superiority, a new supernumerary grade had been invented, called *Mel-teg*, literally "The *Mal* who stays at home," referring to the vows of abstinence taken after the *Maki*. It is amusing and significant to note that, according to Mr. Harrisson, the young men have again asserted their equality and that now most men on Atchin possess the title *Mel-teg*, and apparently for the moment, in this respect at any rate, democracy has reasserted itself, for there is no record of any further supernumerary grade.

The younger generation of natives made use of the white man's coming not only in the direction of freeing themselves from the domination of the older men. With the acute dramatic sense which is the essence of their culture they had also made up to some extent for other deprivations which the white man had brought about by using both him and his inventions for the enhancement of their already rich ritual life. Pantomimic representations of various aspects of the white man's activities had been incorporated into the dramatic repertory of the *na-leng* plays and dances, muskets were used to heighten the effect of ritual combats during the sex-initiatory expedition to Omba, into the more serious initiation rites on Atchin, in which hoaxes are performed on the initiates, more than one white man's *tour de force* was incorporated, and many of the masks and images were made lurid by means of Reckett's blue.

It is however significant to note that, even in the case of such a wide departure from native tradition as the abandonment of the manufacture of their own long-distance canoes in favour of white men's whale-boats, the old consecration rites were still continued. At one such consecration rite at which I was present over sixty valuable tusked boars were sacrificed, and the supreme sacrifice was that of a bullock, obtained from a trader, for which all the complicated sacrificial ritual was performed; while in the pantomimic dances the skulls of a bullock and two goats were used as masks.

One final word as to the causes of depopulation. At the time of my visit the population was on the decline. Of physical causes the chief was, as has been seen, the introduction of the musket which turned comparatively harmless semi-ritual combats into lethal battles. Second to this, the introduction of diseases, mainly of dysentery, which wiped out whole families. As to the psychological causes put forward by Rivers and others but denied by Mr. Harrisson, all I am able to say quite definitely is that there was at that time a general belief among the older men and some of the young ones that the race was doomed. The old men remembered the day when native culture was the highest achievement of the human race as they conceived it. The appearance

of the white man made this position untenable, and they could conceive no possible compromise. If the white man stayed they must die out, as had so many of their neighbours. Some of the young men also said, "What, if this be the case, is the use of rearing children?" and there is no doubt that among this section of the community abortions were common, as pedigrees bear out in the clear diminution of the number of births. There was however a third section of the community, the younger men who had never known the time before the white man came, who were already born into an atmosphere of inevitable compromise, for whom the glamour of the white man's superior material civilization was tempered with a shrewd sense of his weaknesses and some knowledge of how to deal with him. These were the men who were bent on rehabilitating Atchin culture, while at the same time incorporating into it such new elements as seemed not to conflict too greatly with it. One such was Lawak, then my chief friend and informant, now, according to Mr. Harrisson, the most influential man on the island, who had spent two years of his youth in the French penal settlement of Noumea, who was one of the few young men of my day to take to him two wives, and who, his first wife being sick, himself reared her baby son by feeding him on the juices of fruits; nor shall I ever forget his delight when the boy first began to run. I must confess that in 1914, while admiring their efforts, I had little hope in their ultimate success. Time has shown otherwise. The population has increased and is increasing now. It is to such men as Lawak who, through knowledge of the white man and how to deal with him, had hope in the future but at the same time preserved their independence of mind and love of their own culture, that the present increase in population and renaissance of culture is due.

The author is hoping to publish a detailed account of the social organization, religion, language, music, and sea-faring activities of the inhabitants of the small islands off the north-east coast of Malekula, in a series of volumes entitled, 'Stone Men of Malekula.' The first volume, dealing with the island of Vao, is to appear this autumn.

BIBLIOGRAPHY

Deacon, A. B. 'Malekula,' London, 1934.

Layard, John. *Journal of R. Anthropological Inst.*, vol. lviii (1928), p. 203.

———. 'The Journey of the Dead,' from 'Essays presented to C. G. Seligman,' pp. 113–142. London, 1934.

———. *Folklore*, vol. xlvii, June, 1936.

Speiser, Felix. 'Südsee, Urwald, Kannibalen,' Leipzig, 1913.

REVIEWS

EUROPE

EAST SUFFOLK REGIONAL PLANNING SCHEME. Prepared for the East Suffolk Joint Regional Planning Committee by PATRICK ABERCROMBIE and SYDNEY A. KELLY. *Liverpool: University Press—London: Hodder and Stoughton*, 1935. 12½ × 10 *inches;* xx + 112 *pages; illustrations and maps.* 7s 6d

The aim of this volume, which has the support of the administrators of fifty-nine-sixtieths of the county area and eight-ninths of the population (only Ipswich and Stowmarket districts not participating) is directed to arousing a general preparedness to prevent haphazard development. As the authors realize, a clear grasp of the physical background is essential before any plan can be created, and the text of this volume shows that East Suffolk has been examined with care. What is lacking from the geographer's point of view is a set of maps and diagrams that bring out the innate character of a region as such. The maps that are an important part of the argument are well drawn and reproduced, but suffer from a drawback that is common to all those of the region as a whole, viz. all detail, save roads, ceases at the county boundary. This handicap is well seen in the map of the relief. Here a colour is placed over the extra-East Suffolk Region that approximates to the highest layer tint giving thereby the appearance of a plateau borderland. The layer tints, while conventional, range from deep green to brown merely to show from sea-level to about 300 feet. The estuaries of the streams are tinted deep green instead of the blue to show tidal waters, while with the Orwell estuary the brown tint continues to the middle of the channel, which is the administrative boundary.

The analysis of the industries is sketchy, probably owing to the exclusion of Ipswich, but the treatment of the transport facilities is more useful. The map showing the zones of 'bus accessibility would be improved by circles showing the regions that are served from the various railway stations. This would demonstrate that northern Suffolk is not so isolated as appears from the present map. Again, if the road that runs parallel with the northern boundary had been considered in the examination of services it would have removed the anomaly caused by an administrative boundary.

The final map in the volume is one in lurid colours showing suggested types of utilization by which development should be controlled. It is impossible to believe that the tongue that runs north from Lowestoft had not been considered in relation to regions adjoining, and it is a matter of regret that such information is not included, at least tentatively, on the map.

To conclude, this volume is one of great value both as a current handbook and a record, and it is to be hoped that in later reports the authors improve the cartography so that it ranks on as high a scale as the text and the photographs.

A. C. O.

THE COUNTY OF SUSSEX. By HILAIRE BELLOC. *London: Cassell & Co.*, 1936. 8 × 5½ *inches;* x + 214 *pages; sketch-maps and diagram.* 7s 6d

Even in the spate of books on the county this admirable sketch in broad outline may be strongly recommended to both strangers to, and residents in Sussex. "Its purpose is to make known Sussex to those who have not known it, through its physical character and its past. The moment is opportune, for Sussex is in peril of dissolution." At least this book may help in some degree to preserve the memory of what Sussex was even thirty or forty years ago when we tramped

along the Downs or athwart the Weald. It is a sad irony that the county which historically so long stood apart should develop its long fringe of watering places (40 miles of houses) as London outposts; but the nearness of the coast-line to London and the coming of petrol are explanation enough. For a time the roads to Eastbourne, Brighton, Worthing, and Bognor may keep the traffic fairly canalized, but the week-ender and his pleasures will soon inevitably encroach on the intervening spaces of the Weald, and the Sussex downsmen will have much ado to keep some part of their territory unsullied. Resistance will be greatest in the latest exploited region of Kirdford and North Chapel.

Quite properly Mr. Belloc's main theme is that Sussex has grown from the sea through the prehistoric, Roman, Viking, and Norman periods: "the tides of the Channel were the creators of the County." There is a rare breadth of view in his treatment, comprising analogous and contrasted developments in European countries; and it moves easily along the path of big generalizations springing from life-long thought on the subject. Of course the author makes his playful strictures on the conclusions of "academic men." He is himself, we think, inclined to make too much of the "military" character of the Roman roads through Sussex, and he might have added one more to their number, that recently proved from the Ouse at least as far as the Arun. Alfoldean, embanked in the way common with ordinary civil settlements, was hardly a "fortified station." At its foundation Hardham Priory can scarcely have owed its site to the neighbourhood of Stane Street, which had here been blanketed for centuries, but rather to the Saxon way which succeeded it. It is claimed that Frant is "undoubtedly" of great antiquity; the earliest we know of it is that there was a chapel at "Fernet" before 1100. The prehistoric route along the South Downs is underrated: "We may presume that before the Roman order came to us the waterless Downs were deserted." This route is not cut off from the west by Hampshire inlets, nor was metal the only commodity carried along their tracks by men of the Neolithic, Bronze, and Early Iron Ages. We are told that Coldharbours often mark the points where Roman roads were compelled to swerve: surely this is pure fancy. The author still stoutly defends Portus Adurni as the Roman port at the mouth of the Adur. Ad Decimam—that is, Ad Decimum (miliarium)—the invention of Richard of Cirencester, is not worth quoting nowadays, skilfully though the forger calculated the distance to within 150 yards. The mill pond at Midhurst is not the head of the Western Rother: the stream rises many miles westward at Nore Hill, near Selborne, in Hants. These points show that a few of the author's generalizations and statements need not be accepted too uncritically. S. E. W.

POPULATION OF GREATER LONDON. Scale: ½ inch to 1 mile. Distribution of population compiled by A. C. O'DELL. *Southampton: Ordnance Survey*, 1935. 35½×29 *inches*. 1*s* 6*d*. *Sheet of profiles*, 9*d*

The area shown on this map extends from Royston in the north to Horsham and Crowborough in the south, and from Farnham in the west to Chelmsford and Rochester in the east, over an area of about 71 by 57 miles centred on London. The most prominent features are the brown shadings which mark the population densities. There are eleven of these, ranging from dark purplish browns for the higher densities down to a very light yellowish brown for the lowest density shown. The last is so pale that it is not easily distinguishable from the white of the uninhabited areas except in good daylight. In addition public open spaces are shown in a pale green and water surfaces in blue; while names, boundaries, roads, and railways are printed in black.

The colours are decidedly more attractive than the dull browns of the

Population Map of Great Britain; though the colour scale is similar and is open to the same criticisms (see review in the *Journal*, 1934, vol. 84, pp. 258–260); but the scale of densities is very different. Here only the lowest density (0 to 102 per square mile, 0 to 0·16 per acre) can be classed as rural. It corresponds to the densities from "Very Sparse" to "Thin Rural" of the earlier map. The next grade (102 to 960 per square mile) clearly reaches urban figures; and thus the map shows ten grades of density of urban population, the last five of which are all denser than the townplanners' suggested maximum of 60 persons per acre. Unless the reader remembers that ten of the eleven tints indicate urban conditions he will obtain a very misleading impression, and he may badly underestimate the real urbanization of Greater London.

With this in mind the map gives a clear picture of the main facts of the distribution of London's population. There is a minimum of only 5 per acre in the City; and that area has a mean density of less than 7·5 per acre. There are three dark stains which mark densities of more than 200 per acre (128,000 per square mile) in Southwark, in Paddington, and just east of King's Cross Station respectively. These are the maxima; though several areas scattered between Ealing and East Ham have more than 100, a density which is reached in only one place, Watford, farther out. Yet the darkest areas are broken up to some extent by the white patches which mark uninhabited land. These include the Dock Estates, marshlands by the rivers Thames and Lea, some open spaces such as Kew Gardens, aerodromes, athletic grounds, golf links, and large works areas such as railway marshalling yards, etc. They are presumably the areas in which no persons were registered on the night of the census, though some of them are very crowded during working hours. Their white emphasizes the isolation of the few dark patches of overcrowded slum which are islanded in London's Dockland. Some areas shown in the lowest grade of density, as in the City and Whitehall, are areas which are crowded during working hours but left to a few caretakers at night. The suggestion that these areas are unoccupied is misleading; though it follows inevitably from the *de facto* census figures which count each person in the place where he stayed the night, or arrived next morning after his night's work. A map based on the *de jure* census, which registers each person at his regular address, would have similar deficiencies.

The outward spread of the more densely peopled suburban areas fits no regular pattern; it is neither radial nor concentric; and, while patches owe their development to older towns or villages, to railway stations, or to recent housing estates as at Dagenham and Watling, yet the general distribution suggests a disorderly sprawl, checked only by a need for road or rail connection with the focal areas of the Docks or the City.

The sheet of profiles which accompanies the map is a new feature. It has five relief profiles, on a horizontal scale half the linear scale of the map, with a tenfold vertical exaggeration. On each is superposed a "density profile." The advantage is the amazingly vivid portrayal of the many abrupt changes in density; and the profiles are thus very useful as correctives to the assumption, often subconscious, that changes in density of population resemble changes in relief and can be correctly represented by some series of isopleths. No one who studies these profiles in relation to the map can retain that common misconception; and the profiles form a challenge to the method of representation used on the map. The fact that the population "profile" is on the uneven base formed by the relief profile makes it somewhat difficult to read. It would have been easier if the density shading had been repeated on the profiles, which are in a uniform brown.

The only boundaries shown on the map are those of the Administrative

Counties. For future editions we would suggest that the map should include all the definite boundaries of the various "Londons"—not only the County, but also the City and Metropolitan Police Districts, which together form the "Greater London" of the census, the area of "Transport London," and the limits of the Port of London. The last-named extends eastward beyond the edge of this map; but it should be included in any complete map of Greater London.

Many of the names printed are irrelevant to the purpose of this map. The names and initials of the four main-line railway companies appear many times; but a large majority of their stations, which are often nuclei of suburban population, are unnamed, as are also many of the lesser suburban districts, towns, and villages. All the reservoirs shown have the conventional black-line edging and blue shading; it seems unnecessary to add the word "Reservoir" or "Res^{r}". The important names are those of human settlements: *e.g.* Mill Hill, Esher, and Kingston might well be named and the names of the Basingstoke Canal and the Duke of Northumberland's River (1,116; 1,301) omitted.

The material for the compilation of this map included the published statistics of the last census, the relevant sheets of the 5th edition of the O.S. 1-inch map, and personal investigation of some areas by the compiler. Apart from the use of the actual census cards which record each household, the smallest areas for which records are collected are the enumerators' districts; but the smallest areas for which the figures are published are wards (in towns) and civil parishes. Access to the more detailed unpublished census material might have enabled the compiler to reach greater precision in some areas. For instance it seems probable that the local density on ground occupied by some of the large blocks of modern flats is higher than that shown on the map, which is based only on knowledge of the total population of each ward plus a knowledge of the distribution of buildings and open spaces. It is very desirable that the map should show the concentrations of population in such blocks.

It is to be hoped that this map is only the first of a series; and that after the next census more co-operation between the Census authorities and the Ordnance Survey will both improve the map and enable it to be published nearer to the date of the census. Mr. O'Dell is to be congratulated on his work; but more workers are needed if such a map is to be available to the public soon after the Census to which it refers. C. B. F.

THE STRUCTURE OF THE ALPS. By LÉON W. COLLET. Second Edition. *London: Edward Arnold & Co.* 1935. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xvi+304 *pages; illustrations and maps.* 20*s*

This volume of 290 pages is the second edition of a book published by M. Collet in 1927. The work has been brought up to date in all its parts and several new chapters have been added, including a new part devoted to the continuation of the Alpine Range in the Western Mediterranean.

In Part I the leading types of deformation and mountain structure in the Alps are described. According to M. Collet, the term *nappe* is now used in a general way to cover the great recumbent anticlines of the Western Alps in which the inverted strata form a reversed limb, and all gradations of deformation of overcast and recumbent anticlines. He points out that in the High Calcareous Alps (the limestone ranges north of the Rhone and Vorderrhein valleys) the *nappes* are severed rock-masses which have been driven forward upon clean-cut thrust-planes, whereas the *nappes* of the Pennine Alps south of these valleys are essentially recumbent anticlines.

Argand's diagram is reproduced, showing the principal stages in the forma-

tion of the Western Alps from Carboniferous time to the Middle Tertiary epochs of intensive folding and uplift. M. Collet adopts Argand's interpretation that the sedimentary deposits of the main chain of the Alps accumulated in a geo-synclinal basin forming the northern part of a wider Mediterranean, and that the sea-floor rose to a submarine plateau on the north with inner seas and lagoons in which the calcareous and shore deposits of the foreland of the Alps gathered.

M. Collet accordingly differentiates in his tectonic classification of the Alps between an *inner zone* containing the Pennine Alps and an *outer zone* associated with the original foreland. He includes in it the crystalline Hercynian Massifs of Palaeozoic age, the High Calcareous Alps, the Swiss Plateau and the Jura Mountains. The Hercynian Massifs are those of the Aar-Erstfeld and St. Gothard Massifs, Mount Blanc and the Aiguilles Rouges, Mount Pelvoux and Belledonne, Mercantour. Both zones follow the western bow of the Alps to the Mediterranean.

Parts II and III form together the major portion of the work. They describe in considerable detail the geological features in the mountain ranges of the Foreland and the Pennine Alps respectively. Two chapters deal with the geology of the Jura Mountains and the Swiss Plateau. The stratigraphical sequence of the High Calcareous Alps is given, and attention paid to the fossiliferous zones.

The outcrops of each of the *nappes* is followed in the Zermatt district and their intricate tectonic features are described in great detail both in the valleys and the famous mountain groups. The localized back-folding of the Great St. Bernard *nappe* to the south in the Mischabelhörner is explained. And a tectonic map of the Val Tornanche and Aosta Valleys sets forth the presence of the two higher *nappes* in the transversal synclinal depression of that area.

M. Collet deals briefly with the Eastern Alps in Part IV, limiting himself mainly to the evidence of their tectonic relationship to the Western Alps. The thrust-masses of the Rhätikon and Upper Engadine in the Eastern Alps override various groups of rock belonging to the Pennine *nappes*.

The Oetztal *nappe* continues eastward, forming the main chain of the Eastern Alps to Graz and the Eastern Plain. From the exposures of the underlying horizons in the "tectonic windows" of the Lower Engadine, the Hohe Tauern range and at Semmering, M. Collet supports the view that the Pennine *nappes* do not die out in the Engadine but extend underneath the 'Austrides' of the Eastern Alps. Certain very debatable points are raised in M. Collet's treatment of a "Styrian *nappe*" suggested by Staub, the Drauzug, and the tectonic relations of the Northern Calcareous Mountains.

Part V deals with the origin and structure of the ranges of the Prealps, that extend from Lake Thun to Lake Geneva and the River Arve.

In the Final Part M. Collet brings forward additional observations made by Zaccagna, Staub, Merla, and others in the mountains of Liguria and Tuscany. He concludes that the Northern Apennines from Genoa to Orbitello belong, geologically speaking, to the Alps. In the eastern part of the island of Elba he demonstrates two *nappes* of Pennine type resting upon a granite substratum presumed to be part of a Hercynian Massif in an Alpine Foreland. The island of Corsica also shows a sedimentary region of Alpine character and a granite region probably representing Foreland. No complete survey is available of the mountain systems in Spain, but M. Collet regards the Alpine Belt as represented in the Betic and Sub-Betic mountain chains of Southern Spain. He considers the evidence at present insufficient to determine whether this chain unites with the Rif in Morocco or strikes east–west and terminates in the Atlantic Ocean.

Throughout the volume a bibliography is given at the close of each main part. The numerous plates and illustrations and the tectonic map at the end greatly facilitate the study of the work and enhance its value to the reader. The volume must rank as an important contribution to the literature of mountain-structure and in particular of Swiss geology. M. O. G.

ASIA

DAS CHINESISCHE REICH. By GEORG WEGENER. (From 'Handbuch der Geographischen Wissenschaft.') *Potsdam: "Athenaion,"* 1936. 11½×9 *inches;* 245–434 *pages; illustrations and maps*

It is not evident from anything between the covers of the volume just for which section of the reading public this tastefully produced work is intended. Beyond the facts that the paging starts at 245 and that the first page begins abruptly "III. Zentral- und Ostasien, A. Das chinesische Reich" there is no indication what relationship it bears to the larger publication of which it is apparently a section. In the absence of introduction, table of contents, chapter headings, and index, the reader is left to suppose that he may find enlightenment by referring to the 'Handbuch der geographischen Wissenchaft.'

The author is professor of geography at the Berlin Wirtschaft-Hochschule, and for much of China is speaking from personal knowledge, which he has already put to good account in previous publications. This book seems intended to make descriptive geography palatable to the semi-scientific student of the subject, and gives a readable summary of information concerning China, most of it already familiar in substance to the scientific geographer. It starts with a useful outline of the growth of western acquaintanceship with China, drawing extensively on von Richthofen, and follows this by a few pages on the origin and growth of its political divisions, before embarking on the tectonic structure and its geomorphic expression. Thereafter brief, somewhat superficial attention is given in turn to the physiographic regions, the climate, rivers, flora and fauna, races, culture, natural products, architecture, and customs, ending with a short review by provinces of China proper and her dependencies.

The volume is abundantly illustrated, preference being given to new photographs by Boerschmann, Heim, Stubel, and the author himself. This commendable desire to use new illustrations rather than the "hardy annuals" of the text-books gives us much excellent material of real value. In some cases however it must be confessed that the half-tones are not shining examples of good photography and are inferior to more familiar pictures of the same features. The elegant pages of the book are adorned by coloured reproductions of paintings by several artists, mostly by Professor Carl Kappstein. A black-and-white photograph, by its failure to throw emphasis where colour would catch the eye, often misses the outstanding feature of a landscape. But the welcome use of coloured illustrations needs artistic self-control if false impressions are not to result. The painting of Shansi loess country is of real merit and fidelity, but attention is not drawn to the fact that the smooth green spread of the foreground is an ephemeral sight, seen only for a day or two in the year at the very moment when the first blades of the crops are sprouting. The Yangtze is seldom the blue-and-green water of Plate XIX, and the picture of the Temple of Heaven misses the truth both in colour-effect and setting, apart from the anachronistic pigtail in the foreground. The text uses the form "Peking" throughout, though some of the maps show "Peiping," and there are other points where a lack of uniformity suggests that use has been made of previously collected material instead of going in all cases to the latest sources.

Such details of criticism however will not trouble the average reader in Germany for whom the book is primarily intended. Others will find it not only readable but informative on points noted by the author during his travels but apt to be overlooked by writers on China. G. B. B.

DÄMON HIMALAYA: Bericht der Internationalen Karakoram-Expedition 1934. By GÜNTER O. DYHRENFURTH and others. *Basel: Benno Schwabe & Co.*, (1935). 10×7 *inches;* viii, 110 *and* [80] *pages; illustrations and maps.* 10 *Fr.*

This book is the account of the International Karakoram Expedition of 1934, led by Professor Dyhrenfurth to the Baltoro Glacier and the peaks in the neighbourhood of K_2. To finance the expedition the co-operation was obtained of some film magnates who were anxious to get scenes against such a background as this journey would provide. The way this worked out dominates the narrative. Throughout the account there are two groups, a film group and a mountaineering group, almost always in conflict. It began with the moneys being paid in too late to the expedition funds, so that a delayed party was even further held up before being able to get into the field. Once in India, but without the ability to pay the usual advances, they were unable to get the twenty Darjeeling men who should have been the backbone of the transport column; the Balti porters are described as being in any case much less reliable than the Sherpas, and lack of ready money only exaggerated the difficulties.

Once an expedition has special obligations towards a certain group, that group is liable to act arbitrarily and obstruct the work of the rest of the expedition. In this case, for example, the film people decided to reject the manuscript prepared by the leader and act on one of their own. Professor Dyhrenfurth is reluctantly bound to admit (p. 82) that the film work became dominant, that the mountaineering programme could be carried out only in the face of considerable resistance, and that the scientific work fell completely into the background.

In spite of all the troubles, the leader has put together a very readable book. In particular the sections by Frau Dyhrenfurth are well-balanced and interesting without calling on any of the coarseness or silliness which is unfortunately present in one or two of the other contributions. And although the book is written by various hands, the continuity is well maintained to give a very clear picture of the expedition. The photographs, of which there are more than one hundred, are excellent; but they are crowded together at the end of the book instead of being placed in the text; and as if to accentuate the fact, repeated reference is made in the text itself to the distant illustrations.

One is impressed by the good spirit shown by Ertl and Höcht; and by Frau Dyhrenfurth's courage, not only in climbing to 24,375 feet, thus exceeding by a wide margin Mrs. Bullock-Workman's climb to something rather less than 23,000 feet, but also in organizing the party in very difficult circumstances. The question of the height of "Queen Mary Peak," about which there has been much discussion, is dealt with in a separate chapter; it is there argued that the principal peak is not the summit observed by Peterkin, and the height they determined, by aneroid from measured heights in the neighbourhood, is 25,510: a result on which judgment must be reserved. E. H. S.

LE PLATEAU DE MEGHALAYA (GARO–KHASI–JAINTIA). By SHIBA PRASAD CHATTERJEE. *Paris: Les Presses Modernes* [*London: "The Bibliophile" (Little Russell Street)*], 1936. 10×6½ *inches;* 168 *pages; illustrations and maps.* [10*s* 6*d*]

By analogy with the universally known name Himalaya "abode of snow" Dr. Chatterjee has coined the term "Meghalaya" or "abode of cloud" for that

well-marked though, in detail, little-known region of India which geographers have been content to call variously the Assam Plateau or the Shillong Plateau. Although in many ways the upland which rises like a steep-sided island north of the Sylhet plains forms a unit, it consists of western, central, and eastern portions known respectively as the Garo, Khasi, and Jaintia hills. Although sharing common climatic features and a common basal structure of ancient crystalline rocks, the three parts offer a number of contrasts. The Garo Hills (as clearly shown by Fig. 3) comprise a dissected plateau with a fringe of lower hills and in general covered with tropical forest; the Khasi Hills consist of a lofty plateau reaching over 5000 feet above sea-level (and hence covered with temperate grassland and forest) and presenting a precipitous face to the south; the Jaintia Hills have the most accidented topography of the three parts.

In this able and interesting monograph Dr. Chatterjee has presented what is probably the first regional study of the French type to be made of any region of India. He has used the limited literature and his own observations well; the line drawings based on photographs are instructive and the maps in the text both valuable and appropriate, though they suffer from excessive reduction. The emphasis throughout is on physical geography; togography, structure, climate, and vegetation are carefully related. The whole area consists of a massif of pre-Cambrian rocks—a detached fragment of peninsular India—which has been subject to vertical movements in Cretaceous and Tertiary times. The ancient rocks are covered in the centre with *trap* but the oldest sedimentary rocks overlying the ancient block are Cretaceous, succeeded along the southern borders by Eocene and Miocene. These sedimentary rocks remain almost horizontal, thus bearing witness to vertical movements of uplift. The great earthquake of 1897 was but one recent manifestation of forces which have long affected the area. The region has the ordinary monsoon climate of India but boasts, in Cherrapunji, the rainiest known station on the Earth's surface. Shillong is the only other full observing station (six others record rainfall only) but the most is made of the information available. Similarly scattered information on vegetation is collected and a map of the whole is given.

The memoir concludes with a general review of the population and their activities and the whole forms an important contribution to the study of Indian geography. L. D. S.

AFRICA

GENERAL RIGBY, ZANZIBAR AND THE SLAVE TRADE. Edited by Mrs. CHARLES E. B. RUSSELL. *London: George Allen and Unwin*, 1935. $8\frac{1}{4} \times 5\frac{1}{2}$ *inches; 404 pages; sketch-map.* 16*s*

As the work of General Rigby has been overlooked by the standard biographies and text-books, this account of him by his daughter is more than welcome. At the age of thirty-eight he was sent as Political Agent to Zanzibar, and he remained there three years. He began by successfully supporting a weak Sultan against a rebellion fomented under the auspices of a foreign Consul, thereby laying the foundations for the Protectorate and contributing his share towards the "all-red" route from the Cape to Cairo. At the time however he was better known for his attempt to suppress the export of slaves which, in defiance of treaties and maintained chiefly by French and Portuguese interests, threatened to ruin all legitimate trade. Rigby compelled British subjects to free their slaves; eight thousand were liberated while he was there. Illness forced him to abandon his post in 1861. He himself recovered, but his policy suffered a relapse. His successors were of a more compromising turn of mind, and the

Home Government began to vacillate, although it had the full support of public opinion in this country, and there were signs that elsewhere, especially in France, feeling against the trade was growing. Slavery was not finally abolished in Zanzibar until 1897.

Apart from the rebellion and slavery, Mrs. Russell has a long chapter on Rigby's relations with the African explorers. His differences with Burton are dealt with in a reasonably objective manner; but it is questionable whether, in view of Burton's known eccentricities, much is added to Rigby's stature thereby.

There is a very sympathetic and often amusing account of Rigby's childhood and upbringing. The General travelled extensively, but his travel journals prove somewhat orthodox, despite the talents of their author. It is to be regretted that his career ended, somewhat abruptly, with his retirement and marriage in 1867. Careful use has been made throughout of the General's diaries and correspondence. By an oversight, Kilwa has been omitted from the map; and Magadosha is perhaps more familiar as Mogadisho. A portrait would have been a welcome addition. J. P. H. M.

THE ECONOMIC DEVELOPMENT OF THE BRITISH OVERSEAS Empire. By the late L. C. A. KNOWLES and C. M. KNOWLES. Vol. III. The Union of South Africa. (London School of Economics and Political Science. Studies No. 110.) *London: George Routledge & Sons*, 1936. 9×5½ *inches*; viii+356 *pages; map.* 10*s* 6*d*

Much research into reports and official documents has been undertaken in preparing the material for this volume, planned by the late Professor Lilian Knowles, and mainly due to the devoted labours of Mr. C. M. Knowles. The book justifies its preliminary title: nothing is included that is not definitely economic in the wider sense or that has not direct bearing upon that side of life; but the economic historian is soon led into a study of the social organization which provides the framework, and in new countries often shapes the economic activities. Thus we have here, properly speaking, an account of the economic and social development of the area comprised within the Union. In this account references to the geographical background are generally slight, nor is the map supplied very helpful, being purely political and to a scale of 225 miles to an inch.

The historian who aims at covering a period of centuries of development has to choose between the difficult course of proceeding chronologically and trying to hold the threads of all the various movements together without entanglement, or that of taking each of the outstanding branches of activity in succession and tracing development therein throughout the period surveyed. The authors have quite properly adopted the latter alternative, but in the result the reader feels at times the rather violent switch from the present day at the close of one chapter to the simple beginnings at the start of the next. The compact accounts of the development of farming industries, of mining, communications, trade relations, and the native question are provided with hardly sufficient cross references to dispel the reader's sense of being somewhat lost in time. Some of these chapters are however excellent essays in economic history, and the book as a whole is not only a useful work of reference but the most authoritative on the Union of South Africa of its kind. The quotations, the footnote references, and the bibliography all bear the stamp of official sources of material. In fact, this insistence upon the documentary seal for evidence rather deprives the book of the play of colour which the testimony of unofficial persons might have supplied. It emphasizes in particular a dominating and disconcerting feature in the economic life of South Africa, namely the equivocal position of the native majority in a land controlled by whites with chief regard for their own interests.

But the authors refrain from comment or from prophecy: here as elsewhere they leave the reader to draw his conclusions from carefully selected and well-sifted evidence. E. W. S.

LA FRANCE EQUATORIALE AFRICAINE. By GEORGES BRUEL. *Paris: Larose*, 1935. 11 × 7½ *inches;* xii + 558 *pages; illustrations and maps.* 120 *fr.*

A Preface by Georges Perrier and an Introduction by the Author concisely sum up the history of this volume and the accomplishments and aims of France in the vast territory known as Afrique Équatoriale Française which, including the Mandated Territory of part of the original Cameroons, comprises an area more than five times the size of the mother country. M. Bruel deals very effectively with his subject, a complex matter, for it is no slight task to grapple with the mass of detail necessary properly to describe an area stretching from Nigeria to the Belgian Congo and the Anglo-Egyptian Sudan, extending northwards to Lybia and joining hands with the even huger Afrique Occidentale Française on the north-west. By virtue of its size the problems to be undertaken multiply themselves, the transition from the uniformly humid dense forests of the coast to the violent temperature fluctuations and semi-desert conditions of the neighbourhood of Lake Chad, brings for solution and achievement most of the difficulties and possibilities which beset the administrator in Africa. Those who know the adjacent Protectorate of Nigeria will readily appreciate this point and the remark made on p. 485, when the author, speaking of his hope for a transcontinental railway from the French projected "Transsaharien" line to Stanley Pool *via* Nigeria, says, "le problème africain est un, malgré sa diversité apparente."

M. Bruel divides his description into parts dealing first with the climate and geography including geology, a second concerns itself with the natives, a third with "La Colonization," products natural and cultivated, minerals, industry, means of communication, and the like. A fourth describes the judicial, administrative, military, and financial systems. With so large and so diverse a mass of material whereon to comment, a few points only can be selected, and of these the welfare of the Mandated Territory is one of general interest. It inherited from its former owners, as the author remarks, the rudiments of an economic equipment which served as a little dowry in enabling it to continue its career without great financial assistance from France.

No doubt can be entertained as to the result. French Cameroons has an area of 424 million sq. kms. The seat of Administration is now at Yaunde instead of the far less healthy port of Duala, to which it is connected by 224 kms. of railway. The chief exports are palm oil and timber, in 1929 each valued at about 23 to 24 million francs, and palm kernels of more than twice the value of either; that of cacao was nearly 37 million. A quarter of the exports go to Germany. The general depression lowered the values of crops and harvests during the last three years, but in spite of this the graphs given show a very real and solid advance in development. In 1932 the Cameroons budget amounted to over 62 million francs. England was responsible in 1929 for 24 per cent. of the imports, of which cotton goods are the most important. In the same year the total value of the trade of the Mandated Province was slightly more than 350 million francs: that of Afrique Équatoriale Française 540 million, the former nearly 40 per cent. of the whole. In 1931 over 400,000 francs were allocated to the suppression of sleeping sickness. As far as it is possible to judge, mineral wealth is inconspicuous, but in so great a country where exploitation has necessarily proceeded slowly, it is too soon to deliver a final verdict. A well-mineralized district is known running eastwards from Pointe Noire, including

the mining centres of Mindouli and Renéville, where copper and to some extent zinc, manganese, and silver are worked. Gold has been found in several places north and east of Bangui. Indications of petroleum occur along the coast from Duala southwards, a continuation of the long zone of seepages stretching east from the Gold Coast through Nigeria. A geological map on the scale 1 : 8,000,00 shows the general structure of the territory together with adjacent parts of Nigeria, French West Africa, and the Anglo-Egyptian Sudan. Tertiary and Cretaceous beds are confined to a narrow belt along the coast, the greater part of the country being composed of the "Roches Schisto-cristallines" of French and Belgian authors, partially concealed by the freshwater sediments of the "Lualaba-Loubilache" System, and the alluvium and dunes covering vast areas around Lake Chad and Coquilhatville.

About one-third of the book is devoted to the natives, the various tribes being discussed together under such heads as villages, social life, religion, etc., rather than separately as definite entities. This perhaps does not make for clarity. Sections dealing with sleeping sickness, small-pox, and causes of depopulation are noteworthy. The illustrations—there are ninety-five plates each with two figures—are somewhat disappointing, but the coloured maps, showing the rainfall, zones of vegetation, distribution of the tribes, and the density of population, leave nothing to be desired. Twenty-six diagrams help greatly in illustrating the text. An excellent topographical map on the scale 1 : 5,000,000 shows amongst other details the motor roads, the location of projected railways and wireless stations. It is shaded to show heights above and below 1000 metres. In fine, a book necessary to the student of Equatorial Africa from whatever standpoint. J. P.

REISEN UND FORSCHUNGEN IN ANGOLA. By O. Jessen. *Berlin: Dietrich Reimer (Andrews und Steiner)*, 1936. 11½×8 *inches;* xiv+398 *pages; illustrations and maps. M.*38.

This monumental work on geographical exploration in the Portuguese West African Colony of Angola is written in the classic style of the great explorers. Professor Jessen finding the literature on Angola somewhat contradictory, and realizing that this colony has become the goal of many German emigrants, set out in 1931–32 to make an exhaustive study of the general conditions with regard to European settlement. With the help of a German Society and the goodwill of the Portuguese authorities, who instructed the natives to render him every assistance, he was able to carry out eleven different explorations, whereby he made a thorough investigation of the formation, climate, and agricultural possibilities of all the most important parts of the country. On each expedition the Professor's objective was the western highlands with its imposing descent to the coast. He claims that these highlands have never been geographically explored, although he admits that the colony is well served by roads and railways.

As the main massif of Africa is, in Angola, built up of several vast plateaux, the study of this formation promised interesting results in determining the origin, age, and number of steppes which are so important in explaining the development of the continent and of the South Atlantic Ocean. His discoveries of marine deposits on each of these steppes confirmed his theory that the ocean has gradually receded from this part of Africa.

Professor Jessen considers that the situation of Angola, lying between coast, tropical rain-forest, highland, and desert, is of greater interest climatically and agriculturally than any other part of the continent. Not only is the country extremely varied, but its peoples are in more diverse stages of culture than else-

where. These and many other attributes have convinced him that Angola has immense possibilities as a settlement for white peoples.

Excerpts from his expeditions give some idea of the country as a whole. After leaving the pestilential coastlands the route ascends a series of steep escarpments. These reveal grassland plateaux interspersed with valleys which often contain fine stands of timber. Out of these plateaux huge granite outcrops, usually cone-shaped, rise like islands. The colour of the soil changes considerably as altitude is gained and on the highest parts, about 6000 feet above sea-level, the earth is sandy and of a red-brown colour denoting the presence of iron. The Professor found the river valleys distinctly tropical and often teeming with mosquitoes, but the highlands were delightfully dry and even frosty at night. In the lowlands he saw many signs of damage done by locusts and noticed that the natives collect these pests for food. In the tropical rain-belts the forest is still magnificent, but it is being rapidly denuded by wasteful methods of farming. On the high grasslands there were plenty of traces of animal life, but the fauna of Angola has been much reduced by the hunting propensities of the natives and early Boer settlers.

The author visited a number of European-owned farms, mainly situated in the highlands, and was much impressed with the work already done by Germans who have moved in from South-West Africa since the war. He noted that missionaries of all denominations are at work in Angola educating the natives and teaching them useful trades. In particular he mentions the valuable medical work carried on among the natives by the Swiss Mission at Caluquembe. His book contains much interesting information about the native cultures but is somewhat vague in tracing the origins of the various tribes. In Central and South Angola the natives appear to be of Vimbundu stock, but in the north they belong to the Congo types. However all show traces of Bantu origin and have undoubtedly been warlike in the past. Unfortunately little trace could be found of the fierce and cannibalistic Jagga tribes mentioned by the early Portuguese explorers. There is no doubt that the population has increased enormously since slavery was abolished, so there is likely to be ample labour for all purposes.

Professor Jessen states that the majority of Portuguese settlers are traders and they control most of the aboriginal barter trade. He is of opinion that contact with Europeans, especially since the Lobito Bay–Benguella–Katanga Railway was opened, has caused deterioration among the natives. Numbers of them work on the roads, railways, and in the mines to the detriment of their communal-peasant life, and the policy of the Portuguese Government in undermining the power of the chiefs will prove disastrous in the long run. He concludes by reducing his deductions regarding the aspect of the country to five distinct sections: the Swamp Country, the Dry Forest, the Border Mountains or Watersheds, the Middle Wet and Dry Steppes, and the Dry Districts or Plains. He says that the whole country shows definite partitions in the animal and native life, but the natives are clearly blending with one another. Nevertheless it is difficult to determine whether the country has made or changed the characteristics of the natives. From his observations three distinct native types emerge: the Highland Peoples who are the Vimbundu of the dry forest culture, the Northern Peoples who are the Congo–Ambundu tribes of the swampland culture, and the Southern Peoples who are the nomadic tribes of the steppe culture and who greatly resemble the Nilotic peoples of the great lakes.

Apart from the swamp country the climates of Angola are quite suitable for European settlers. Of course the soil and water supply differ in many districts, but the author has seen such diverse crops as oats, pineapples, and coffee, and mangoes, apples, oil palm, and strawberries growing together and all doing well.

He also describes vast areas of good cattle-ranching country, especially in the south and south-west of the colony.

Professor Jessen's observations lead him to favour coffee and sisal as the crops most suitable for Europeans to plant, and he gives the cost of planting these. At the same time he points out that there is little hope for smallholders, and that much capital and experience is needed before embarking on a planting career in Angola. Young Germans are advised to serve for at least two years on old-established farms in order to gain experience of the agricultural conditions, and he tells them that nowhere is the climate quite suitable for white manual labour.

The author reports that the Portuguese Administration has made good progress with the development of the country considering that full control of all districts was not attained until the twentieth century. Besides the valuable data recorded for the use of prospective settlers, this work contains much geographical information and is a worthy addition to the literature on Africa. It is profusely illustrated with good photographs and drawings of native life and culture. There are several profiles of the routes traversed on each expedition, and numerous charts recording the geology, temperatures, and rainfalls.

W. F. deV. S.

NORTH AMERICA

L'EST DU CANADA FRANÇAIS ("Province de Québec"). By RAOUL BLANCHARD. (Publications de l'Institut Scientifique Franco-Canadien.) *Paris: Masson et Cie* [*Montréal: Beauchemin*] 1935. Two volumes. 10×7 *inches. Tome premier* 366 *pages. Tome deuxième*, 336 *pages; illustrations and maps*

In these two volumes are collected five studies which have already appeared in the *Révue de Géographie Alpine*. They deal respectively with the Gaspé peninsula, the Lake St. John and Saguenay area, the North and the South borders of the St. Lawrence below Quebec, and lastly with that city itself. In spite of fundamental differences between the geology of the region north of the estuary and that of the region to the south; in spite of diversities of relief and of shore-line; yet the whole basin of the St. Lawrence below Quebec has elements of unity in respect of morphology and in regard to human geography. The uplands on either side of the lower St. Lawrence for the most part evince two major platforms of peneplanation. The depression occupied by the great waterway itself lies along the sensitive faulted zone at the junction of the precambrian Shield to the north, and the old folded sedimentaries to the south; and it is bordered by populated terraces, the soils of which have been developed upon marine sediments of the Champlain sea. Apart from considerable settlement in the Lake St. John region, inland, but itself invaded and enriched by the same sea, population is almost confined to these narrow fringes, and for the most part the people are of one race, language, and religion. So high has been the birth-rate of these folk, so limited their agricultural lands, and so seasonal much of their occupation, that emigration, both seasonal and permanent, has been a distinguishing feature.

The two fringes of settlement have always been linked with their capital, Quebec, by the estuary. Not, as the author is careful to point out, that these shores are in general accessible to ships of any size, though the main channel is very deep right up to Quebec. It was simply that there was no other means of communication; and when these came, roads and rail alike were confined to the waterside. There are then major elements both of physical, and of human,

geography common to all the areas here separately discussed; and it is an obvious criticism to point out that much of this common material might have been treated together. In fact however the matter is not important. There is actually not overmuch repetition, and what there is serves only as useful emphasis. Professor Blanchard is as much concerned to elaborate differences as to discuss the obvious similarities; and he does succeed in establishing the individuality of his separate regions.

Though his main purpose appears to have been to elucidate what is dynamic in the human geography, yet each study is prefaced by an outline of the physical genesis of the region concerned; and this is by no means a mere summary of existing views with regard to physical evolution, but rather a critical exposition which derives a good deal from the field observations of the author himself. This is particularly so in his interpretative account of the physiography of the Saguenay area. There follows a brief account of the early settlement; and then a more detailed description of economic development and of present conditions and trends. The physical factor is properly emphasized throughout, but its significance is seen to vary in different periods. The development of communications, and the intensification of forest-product industries, are seen as important and somewhat disruptive influences. The amplitude of the studies allows of considerable detailed description and analysis, and the whole work has the form, logic, and lucidity which distinguish the best studies of French geographers.

Professor Blanchard admits to a special and sympathetic interest in these regions of French Canada, and he communicates this interest to the reader. At last we have a worthy geographical study of a major region of Canada.

The volumes are illustrated by a large number of admirably selected photographs, most of them taken from the air. L. R. J.

CRADLE OF THE STORMS. By BERNARD R. HUBBARD, S.J. *London: George G. Harrap & Co.*, 1936. 9×5½ *inches;* 268 *pages; illustrations and maps.* 8s 6d

The "Cradle of the Storms" is Alaska Peninsula and the easternmost Aleutian Islands where the meeting of cold polar air from the Bering Sea and warm southwesterly currents from the Pacific Ocean produces one of the most powerful centres of atmospheric action which, with its unsettled damp weather, hampers exploration seriously. The author, lecturer in Geology at an American University, has led several expeditions to these wind-swept regions. In this book he describes two of the later ones; but the reader tries in vain to find out in what years they were made.

The region joins the wonders of a very spectacular volcanic activity to strong glacierization and one of the stormiest seas to form a very impressive landscape; and the author paints in a very lively manner the experiences of himself, his young assistants, and his powerful pack dogs during his trips. These include the discovery of one of the biggest craters in the world (Galtes Crater) and a second visit to the famous "Valley of Ten Thousand Smokes," which however was found to have lost during the last years nearly all its activity.

The book contains, besides some expeditionary "thrill," scientific discussions disguised as talks of the author with his companions, a form which leads sometimes to undue simplification of the problems. It makes easy reading, but should go far to satisfy the taste of a very wide public; and the geographically interested reader would sometimes have been grateful for more precision and a better map than the quite insufficient one in the cover.

One thing puzzled the reviewer very much. The author who, as a former

student at Innsbruck, should know, tells us that the crews of the salmon-fishing boats off Alaska Peninsula consist to a high proportion of Austrians. One might think of people from Dalmatia; but apparently their mother tongue is German. The author gives no explanation how German-Austrians from a mountain country became sailors in this out-of-the-way part of the world. F. L.

SOUTHERN REGIONS OF THE UNITED STATES. By HOWARD W. ODUM. *Chapel Hill: The University of North Carolina Press* (*London: Oxford University Press*), 1936. 10×7 *inches;* xii+664 *pages; maps and diagrams.* $4.00 (18*s*)

A region, in human geography, must be defined in terms of its peculiar characteristics, and here this is attempted through the application of a large number of statistical criteria which vary from such economic data as the value of farm property, or the volume of production of selected commodities, to such sociological data as those concerned with illiteracy, homicide, and even lynching. It is claimed that 685 indices have been used, and many of them form the basis of distribution maps. Such indices are obviously not of equal significance, and many of them refer to characteristics clearly interdependent. On such statistical bases the writer distinguishes not so much a South, as a distinct South-West and South-East. Maryland, Kentucky, and Missouri do not appear as Southern.

Many of the distribution maps are familiar enough to all who have any acquaintance with the literature; but those on a county rather than a state basis, and some of those appearing in the chapter on Technology, Deficiency and Waste, are more interesting, and provide the basis for further regional subdivision.

The object of it all apparently is to provide a statistical basis for regional as distinct from sectional planning; that is to say, for planning which envisages the region in the economy of the country as a whole, and not as a separate economic and social entity. Economic regional planning premises effective Federal control applied to large-scale schemes of production, exchange, and conservation, into which the lesser activities must fit. The real task, in fact, begins where such works as this end; and though the last chapter is labelled "Towards Regional Planning," it proves essentially slight, and leaves the subject quite in the air. This heavy tome, with its 329 maps and 272 charts and tables, contains some statistical matter of importance, and one might wish that the author's commentary had been more simple, direct, and concise. Even in 300 pages of letterpress, one cannot, in any significant way, refer to all the southern characteristics; and the attempt to do so, marred by a style which too often descends to jargon, results in confusion and considerable repetition.

L. R. J.

AGRICULTURAL PROGRESS ON THE PRAIRIE FRONTIER. By R. W. MURCHIE, assisted by WILLIAM ALLEN and J. F. BOOTH. (Canadian Frontiers of Settlement. Edited by W. A. MACKINTOSH and W. L. G. JOERG. Vol. 5.) *Toronto* [*and London*]*: The Macmillan Company,* 1936. 10×6½ *inches;* xii+344 *pages; illustrations and maps.* $4.50 [17*s*]

The contents of a book with this title will depend on the author's interpretation of "agricultural progress" and "prairie frontier," and so it may be desirable for the reviewer to indicate the scope of the work and the nature of the methods used. "Prairie frontier" is not to be taken literally: for the purposes of this book the object of investigation was the frontier of settlement in the Prairie Provinces, and much of that frontier of settlement lies well beyond the edge of the prairie.

Further, nearly half the book is devoted to what is strictly background to the problem, general aspects of the evolution and characteristics of the agriculture of the Prairie Provinces as a whole. This portion of the book contains chapters on "The Development of Agriculture," "Trends in Agricultural Production," "Investment in Farms," "Land Tenure," and "Ranching in Alberta," which together outline the march of agricultural settlement from the Red River Valley in 1870 to the frontier areas of the present day, and assess the progress (or retrogression!) that has taken place in the settled areas since their first occupation. These chapters have value for their own sake in their mass of interesting statistical and textual information, but their prime purpose in this work is to permit the pioneer areas of most recent settlement to be placed in their regional context, and to afford the reader a regional standard by which to value the methods and achievements of the present pioneers. Rather more than half the book is devoted to accounts in standardized form of intensive surveys in the field of selected areas along the fringe of settlement. It is perhaps a little surprising to find that, while sample areas have been taken from each of the three provinces, Manitoba is most strongly represented, and that one of the Manitoba areas is part of the Red River Valley near Winnipeg. The semi-arid fringe is represented by the Medicine Hat district in south-western Saskatchewan and south-eastern Alberta. (The Peace River District survey has been made the basis of a separate volume in this series.) This part is the real heart of the book, and it provides a mass of information not obtainable except by the man on the spot. This information is mainly, but by no means wholly, of a statistical nature, susceptible to tabulation and to the methods of statistical analysis, but emphasizing the fact that in "agricultural progress" the emphasis is laid on the economic and social results of the farming activities rather than on technical or geographical aspects. Not all of it is of immediate use to the geographer, but all of it is interesting, and as an example of thorough work and orderly exposition it will be hard to beat. Finally two able appendices discuss mechanization of farming in the Prairie Provinces, both in its technical aspects and in its influence on agricultural development. This volume, like others in the series, is admirably illustrated. The pictures are well chosen and excellently reproduced, the graphs, diagrams, and distribution maps are numerous and clear. R. O. B.

CENTRAL AND SOUTH AMERICA

ENCHANTING WILDERNESS: Adventures in Darkest South America. By HANS TOLTEN. Translated from the German by FERDI LOESCH. *London: Selwyn and Blount*, 1936. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 286 pages; illustrations and map.* 15*s*

This is a book of unusual interest. The author is of German parentage, but Argentine born and educated; he was well acquainted with life on the estancia, and in the yerba-growing regions of the extreme north-east of Argentina, before he set out on the first of the adventures related in this volume.

All the events took place in a region west of the river Paraguay, but at no great distance from that water highway, as distances go in South America; a point some 500 miles due west of Asunción, at about lat. 25° S., was reached at one stage, while from north to south the author and his partner travelled over 700 miles, the route lying, roughly, from the Chaco Austral and northwards across the Pilcomayo river into the Chaco Boreal as far as the river Galvan. The time occupied by the two ventures is not stated, but appears to have lain within the whole of a "dry season," about ten years ago.

The first essay led Hans Tolten and his Spanish Basque partner to the open

belts with which quebracho forest is interspersed in northern Argentina, west of Resistencia, and which have been found suitable for cotton growing. The region can scarcely be called "wilderness"; the present reviewer visited many such cotton plantations of the district in 1927, utilizing railways, motor roads, and horses. Many young cotton fields were then obviously suffering from drought, but failure in Tolten's case is ascribed to a more tragic cause. Members of the shy Mocowi tribe, encamped in nearby forest, were induced to work as cotton pickers; but a petty fracas led to intervention by Argentine police, and, according to the author, the whole of the Mocowi tribe were massacred after planters and farmers had fled from devastated homes.

Tolten and his friend next accepted the offer of an old acquaintance who had purchased, on the strength of a map drawn with more optimism than accuracy, a tract of land belonging to Paraguay in the Chaco Boreal. The owner had never seen his property, and asked the author to assist him in locating and, when found, in turning to commercial advantage the tract of a mere 500,000 acres. The Chaco Boreal is, says Tolten, "a joke" in South America's history; it is a territory "of about 115,000 square miles, inhabited by the most warlike of Red hunting tribes . . . yet sold to the last acre!" A few decades ago a Paraguayan Government "hastily sold all government territory, throwing it away, so to speak, between one revolution and the next." No one could check the situation of the tracts in this unsurveyed country and the maps made were "fanciful creations." Few of the owners who remained with nominal possessions after the land boom have ever tried to locate their holdings, unless they lay close to the banks of great rivers. However Don Manuel now set out with Tolten and his partner Paco, to seek his land, the party following from Machagai, north-west of Resistencia, a route that led across the Bermejo river, into the Chaco Central, into the country of the Toba folk, and thence to the Chaco Central and into the territory of the Sanapana tribe. Don Manuel's holding could not be identified, but a prospect of money making opened when a great nesting-place of *garzas* (egrets) was discovered. Since exploitation of the *garzal* entailed, according to Don Manuel's ideas, shooting all the nesting birds, Tolten was unable to endure the prospect, and rather than associate himself with such slaughter, left the scene. The incident is a little obscure, since, ten years ago, egret feathers were no longer the mine of gold suggested; nor is it necessary, as Venezuela has proved in the protected *garzales*, to shoot nesting birds in order to secure fine plumes. However one can but agree with the author's stated point of view, both as regards native folk and wild life.

The translation is good, although slips occur, as when "crocodile" is used instead of the correct "alligator," and when a palm cabbage is said to be cut from the "roots" of the palm. The sketch-map is adequate, and photographic illustrations of native folk excellent. L. E. J.

HISTORICAL GEOLOGY OF THE ANTILLEAN–CARIBBEAN Region: or the Lands Bordering the Gulf of Mexico and the Caribbean Sea. By CHARLES SCHUCHERT. *New York: John Wiley & Sons (London: Chapman and Hall, Ltd.)*, 1935. 9½×6 *inches;* xxvi+812 *pages; illustrations and maps.* 50*s*

This volume is the first of a series on the Historical Geology of North America. In spite of the main title the book deals with a wider region and embraces all the lands around the Gulf of Mexico and the Caribbean Sea, and includes distant Bermuda: for the geological history of all those areas is intimately bound up with that of the Antillean–Caribbean region. For the purposes of geological description the area is divided into seven regions—Mexico (dealt with in some

detail, as it deserves), the Gulf Coastal Plain, Nuclear Central America (the south-eastern states of Mexico to Northern Nicaragua), the Antilles and their Bahaman Foreland, the Young Isthmian Link connecting Central and South America (Panama to Southern Nicaragua), Northern South America (Colombia, Venezuela, Trinidad, Barbados, and Tobago), and the Oceanic Islands (Bermuda and the Caribbean volcanic arc).

Much of the geology of the area is as yet only incompletely known, for there are great tracts in it which have not been explored in detail, and of which our only geological knowledge has been given by the pioneer. Even so a wealth of literature has been created dealing with the region. This is ably summarized in the volume, although necessarily the style is rather staccato in places; and yet the book is still very lengthy. In general, the opinions of the actual writers are quoted, but, where there is a clash between two or more, Professor Schuchert has tried to hold the scales evenly and to assess the merits of the case. In addition, a good deal of new information is provided, often in the form of personal communications from field-workers to the author.

Of necessity the bulk of the volume is concerned with stratigraphical details. But, throughout, there are chapters or parts of chapters dealing with the structural features and development of the various regions into which the area is divided, and including at times new interpretations by the author. These parts of the book, together with the first three sections (which deal more particularly with the greater geological features of the region, diastrophism, palaeogeography, the Central American marine basins, of which three are recognized, and biogeography—chapters in which the author had greater latitude in which to express his own views) will make the greater appeal to the student of geomorphology and geography.

As we expect now from Professor Schuchert in such a book, it is plentifully illustrated with palaeogeographical maps, which are of much value to the reader. A more than usual human touch is given to the volume by portraits of several of the geologists who have contributed so much to the understanding of the region. But it is unfortunate that the high price will put the book beyond the reach of many who would wish to possess it. It is very up to date in its information, and contains a series of extensive bibliographies to the various sections and regions. In addition the letterpress is easy to read, and there is a singular paucity of mistakes of all kinds. The next volumes will be awaited with interest.

H. D. T.

AUSTRALASIA AND PACIFIC

ODYSSEY OF THE ISLANDS. By CARL N. TAYLOR. *New York and London: Charles Scribner's Sons*, 1936. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xiv+284*; illustrations.* 12*s* 6*d*

This book about the Philippines is not very well arranged, but the material in it is sometimes first class, and extraordinarily varied. There is a fair balance between observation and journalism.

Since the battle of Bayan in May 1902 when the native women fought beside their men, at the end hurling their babies into the faces of the American soldiers, and when Captain John J. Pershing first leapt into fame as a soldier, endless war has been waged against the Moros of Lanao. Mr. Taylor arrived at one place two days after it had been shelled. He has some fierce things to say about the chaotic American administration; he is an American. His account of the diabolical methods by which opium and Chinese coolie labour are smuggled in suggests an earlier century. The Bajao sea gypsies, among whom he sailed,

are dying out and nothing is being done to help them. The author gets across to the reader an idea of colourful natives, cruel, but kindly, real people. His feelings about the advancing civilization in the outlying districts is indicated by (p. 97) "They learn—or half-learn—the three Rs and write essays about a dull little boy with a hatchet who cut down some kind of foreign tree, and who was not ingenious enough to tell a necessary lie. A trait of character foreign to the oriental nature, which not even their Christian (Filipino) teachers could understand." T. H. H.

POLAR REGIONS

VI FLYVER OVER ISBJØRNENS LAND. By LAUGE KOCH. *København: Chr. Erichsen*, 1934. 9×6 *inches; 132 pages; illustrations*

A book about Greenland by Lauge Koch, even if it is primarily intended for youthful readers, cannot but be interesting. In fact this book has given the author the opportunity to write some excellent accounts of the way scientists go to work under the conditions of a big modern expedition; much of this valuable material could never have appeared amongst purely scientific reports. Dr. Koch knows both the ancient and the modern style of expeditions; in the course of many years spent in Greenland he has used both sledge and aeroplane to gather as much knowledge of the country as any man could hope to achieve in a lifetime.

In all his travels Dr. Koch's interests have been mainly in mapping and geology; the chapters which describe the life of the survey and geological groups of the Three Years' Expedition to East Greenland are well written and stimulating; the same may be said of the account of the hydrographical work undertaken from the expedition ship. Some of the other chapters seem to have been written to a less severe standard of excellence, but they would no doubt stir the imaginations of younger readers and let them feel that even the highly organized expeditions of the last few years were not without some atmosphere of adventure. The book throughout is informative without being too instructive; but the photographs and the production are disappointing. M. A. S.

PHYSICAL AND BIOLOGICAL GEOGRAPHY

GRAVITY MEASUREMENTS IN GREAT BRITAIN. By Dr. E. C. BULLARD and Mr. H. L. P. JOLLY. *M.N.R.A.S. Geophysical Supplement*, vol. 3, no. 9, 1936, April, *pages* 443–477

The measurement of gravity by means of observing the time of swing of a pendulum was made from time to time during the nineteenth century; and the object of such measurements was the determination of the ellipticity of the Earth's meridian—a quantity necessary in the computations of surveyors. The theorem of Clairaut gives the relation between gravity and latitude on a rotating attractional spheroid; and accordingly from gravity measurements a value of the ellipticity should be deducible. Overlooking the many complications which have since been found to embarrass this question, it was natural that early pendulum work should follow two main directions: (*a*) the design and standardization of pendulum equipment; and (*b*) the use of such equipment at places of widely different latitude.

In the early part of the nineteenth century lived Captain Kater, whose name will be familiar to many as the inventor of the reversible pendulum, devised specially to determine the absolute force of gravity at any point. The problem of determining the length of the equivalent simple pendulum was in this design

reduced to the measurement between two graduations on the stem and avoided the uncertainty of calculating the length for a material pendulum in which absolute uniformity of density and symmetry of form did not exist. Kater made gravity determinations at some seven stations in Great Britain and modern measurements have shown that his values are differentially correct. That the absolute values should be seriously wrong is the irony of fate, for the special feature of his pendulum was designed with this very object.

To pursue the second object of early pendulum work, obviously there was little call for numerous determinations in Britain, and after the observations of Kater just mentioned nothing was done (apart from a few observations now found unreliable) for the rest of the century. On the other hand the English geodesists Airy, Stokes, Sabine, Walker, planned a campaign in India which comprised the measurement of gravity at perhaps a dozen points distributed along a central meridian.

By the beginning of the twentieth century naturally the situation had developed; and with development came much increase of complexity. The original idea of finding the Earth's ellipticity failed owing to crustal anomalies of the Earth. The investigation of these latter called for much greater detail; and in addition defects in pendulum apparatus (notably that of insufficient rigidity of the pendulum support) was found to have rendered the earlier results in many cases unreliable. The plan of operation changed and the objective became the determination of relative values of gravity, while the absolute value of the base station (Potsdam) was a matter of independent effort. Britain was still considered too small a field for profitable gravity measurement; so the work done prior to the war consisted of standardization of sub-bases—determining the value of gravity at Kew and Greenwich in terms of that at Potsdam—which should serve as a basis for work done elsewhere in the Empire. About this time the systematic observation of gravity was commenced and has been steadily proceeded with ever since. During the same period similar work has been done in several European countries and the U.S.A.

As observational results have increased the need for their interpretation has arisen and the original objective of finding the Earth's ellipticity has expanded into the much more complex objective of determining the complicated form which the Earth is now known to have; and in addition the application of the results to geophysical questions of the Earth's constitution, especially as regards its crust. So in 1920 the first British school of geodesy was formed at Cambridge; and owing to its activities, latterly in conjunction with the Ordnance Survey, the number of dependable gravity stations in Great Britain has risen to nearly one hundred. These stations are somewhat strangely distributed and the bulk are to be found in South-West England, Wales, West Scotland, and the Orkney and Shetland Islands, leaving the inland and eastern portion of the island very sparsely covered. Meantime the relative values of g at a number of important points such as Edinburgh, Cambridge, Southampton, Kew, and Greenwich have been firmly established.

Nothing of a highly spectacular nature has been revealed by the observations hitherto done in Britain; but the results make some contribution to the geology of the country. It is to be hoped that the gaps in the gravity survey will be made good in the next decade—and in view of the work already done and the simplified methods of gravity survey which are now developing, this should be neither a difficult nor costly matter. The publication of 'On Gravity Measurements in Great Britain' is of great value in that all that has been effected has been collected and brought into common terms based on the International Gravity formula adopted at Stockholm in 1930.

J. DE G. H.

SOILS: THEIR ORIGIN, CONSTITUTION AND CLASSIFICATION: An Introduction to Pedology. By GILBERT WOODING ROBINSON. *London: Thomas Murby & Co.*, 1936. (Second Edition.) $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xviii+442 *pages; illustrations and maps.* 20*s*

The second edition of Professor Robinson's well-known text-book will be welcomed by all students of the soil. The main features of the first edition remain unaltered save that the appendix on Methods of Analysis has been omitted owing to the appearance of Mr. C. H. Wright's book on the subject. Much additional matter has however been incorporated, including a few corrections and amplifications, but consisting largely of recent work published since 1932. One hundred and fifty titles have been added to the bibliography.

The first edition was hailed as the most lucid and penetrating exposition of soil science that had yet appeared, and this judgment still holds. Alike for professional pedologists and for those who have a less direct concern with the soil, every chapter is of great interest. Especially valuable from the point of view of the philosophical treatment of the subject are the discussion on genetic classification and the author's own tentative proposals for a universal scheme of classification. For all whose interest in the soil is more than "surface deep," Professor Robinson's work is indispensable. It is illustrated by plates and diagrams, and contains an excellent index. J. S. L. G.

SNOW STRUCTURE AND SKI FIELDS: Being an Account of Snow and Ice Forms met with in Nature and a Study on Avalanches and Snowcraft. By G. SELIGMAN; with an Appendix on Alpine Weather, by C. K. M. DOUGLAS. *London: Macmillan & Co.*, 1936. 9×6 *inches;* xii+556 *pages; illustrations.* 25*s*

Mr. Seligman's book represents an extension of articles published by him during the last years in the *British Ski Year Book* (especially vols. VII and VIII). The author intends to explain to the skier and mountaineer the prime causes determining the ever-changing qualities of the snow cover, and thus to make mountaineering and alpine skiing better and safer. At the same time he wants to give to the scientific specialist a summary of the existing knowledge of the properties of snow, to show some unsolved problems and to hint at ways of approach to them. Such double purpose may have caused some difficulties in the composition of a book; they have however to a large extent been overcome by many cross references between the theoretical and the practical chapters and by a certain amount of repetition.

The first part, more than one-half of the book, discusses from a physical point of view the different forms of snow and rime, the qualities of the snow cover and the crystallographical changes which occur in it. The existing English and foreign scientific literature has been fully used; each chapter concludes with a full list of references which will prove the more useful for the detailed study of special problems as there does not exist in any western language a comprehensive treatise on ice and snow such as Dobrowolski's 'Historja naturalna lodu' (Natural history of ice) published in 1923. These scientific discussions are aided by the author's intimate knowledge of snowcraft based on many years of practical experience and his own research on many crucial questions. The often unduly neglected deposits of rime and hoar for which the Welsh word "arien" is proposed as a comprehensive term, are fully discussed. The transformation of newly fallen snow flakes leading ultimately to glacier ice (Seligman's "firnification") is illustrated by a sequence of interesting micro-photographs made largely by the author himself. Among these structural changes wind-packing, producing a hard top layer over looser snow, is of special

interest. There is often a space between the cover and the underlying snow; such "wind slabs" easily break into single blocks which, on inclined ground, give rise to the most treacherous kind of avalanches. Ruling out all other explanations as unsatisfactory, the author proposes tentatively a theory of his own which regards wind-packing as a speeding up of the normal recrystallization of snow under the influence of damp winds. Concerning the formation of cornices the author differs to a certain degree from opinions recently published by Paulcke and Welzenbach (*Zeitschrift für Gletscherkunde*, 1928, p. 42); but further studies are needed to establish the underlying facts. In this as in other cases the lack of information regarding the qualities of snow, so widespread and practically important, is astonishing. The great progress recently made by Sverdrup and Ahlmann in Spitsbergen (*Geogr. Ann.*, 1935 and 1936, see also *Geogr. J.*, vol. 86, p. 97) may however be mentioned.

The second part deals with the mechanical aspects of avalanche development. Undoubtedly avalanches, owing to their great importance for the geography of mountain regions and especially for the skier, deserve an exhaustive treatment, and their systematical study is more advanced than that of other snow phenomena. Nevertheless a rather disproportionate part of the book seems devoted to avalanches compared with the short remarks (chapters XXII and XXIII) which give to the practical skier and mountaineer the application to snow conditions met with during the year of the physical discussions in the first part of the book. This restriction however is made on purpose; the author leaves it to the reader to think out for himself the sequels of his theoretical considerations and refers for actual conditions to A. Lunn's 'Alpine Skiing.' Seligman gives a new classification of avalanches based on the physical qualities of snow; he makes dry-snow avalanches, wet-snow avalanches, and wind-slab avalanches the main headings. Very interesting photographs show the different kinds of avalanches and their effects; but it is remarkable that there is no conclusive explanation for a phenomenon so well known as the destructive blast accompanying certain types of avalanches.

The book closes with practical hints how to avoid the danger of avalanches and how to behave during and after an avalanche accident, and with a summary of typical snow conditions during the different seasons.

C. K. M. Douglas contributes an appendix giving some information on meteorological factors affecting a snow cover, especially radiation, and on weather conditions in the Alps.

The excellent appearance of the book and the numerous well-reproduced photographs justify the rather high price and will make the volume, besides its valuable content, a cherished addition to the library of the glaciologist as well as the mountain lover. F. L.

CARTOGRAPHY

A KEY TO MAPS. By Brigadier H. S. L. WINTERBOTHAM. *London: Blackie & Son*, 1936. $7\frac{1}{2} \times 5$ *inches;* x+208 *pages; illustrations and maps.* 5*s*

To say that this book is interesting, readable, amusing, and up to date would hardly be doing it justice, for it is one of the best short books on this fascinating subject of maps that has appeared in recent times. To endeavour to choose one epithet for it and one epithet alone the word "comprehensive" comes to mind, for in his two hundred pages Brigadier Winterbotham seems to have touched on every item of map making, of map production, and of map reading. It is in fact difficult to think of any points upon which at any rate just a few words have not been written. The principles of helio-zincography rub

shoulders with some practical hints on how to use the thrown-away razor blade as a knife for cutting maps before mounting them, and the book is equally happy in its description of the Transverse Mercator Projection as it is in that of how to erase an evilly drawn ink line attempted by an amateur draughtsman.

Generally speaking it is to English maps and the English countryside that this is the "key," but a short chapter "The Grand Tour" is a mine of information on such maps of foreign countries as are easily obtainable at home. The author, in suggesting that it is a wise precaution to see what is available at Messrs. Stanfords, Ltd., has been a little forgetful of those other map agents, Messrs. Sifton Praed, Ltd., of St. James's Street, who also stock the War Office series referred to. This chapter and Chapters II and VIII entitled "The Night Before" and "Hills" respectively, are perhaps the most intriguing of all the nineteen chapters, though indeed it is difficult to differentiate between any when all are so delightful. Chapter VIII could well be used as a kind of "text-book" résumé on this most interesting subject of the delineation of hill feature, but as a minor criticism it is a pity that the author on pp. 103 and 104 had to adopt that system of referring to his previous paragraphs and to points as (a), (b), and (c); or (1), (2), (3), and so on, which is always so annoying to a reader in a hurry. His remarks on the valuable work done by the old Ordnance Survey hill sketchers have been well merited, for it is to these old hill sketches that one can nowadays refer and be quite sure that the form of the ground is completely, accurately, and conscientiously shown. Given only spot heights and these hill sketches one can in fact contour with considerable accuracy such medium scales as 3 inches to 1 mile entirely in the office and with no visits to the ground whatever.

Throughout the book there are many delightful quotations from old files and from reports of committees set up to investigate this or that about the Ordnance Survey during the last century, which invariably make interesting reading, and which Brigadier Winterbotham introduced to us in that previous work of his, 'The National Plans,' 1934, which has lately been reviewed in this *Journal*. This new book is further enhanced by humorous remarks. Two examples are: "If you fall into a really remarkable ditch or obstacle you will be in luck's way, it will probably be on the map," when speaking of map reading during a fog or bad weather; and "Two straight lines can meet in only one place which will interest you (the other you know is somewhere about Australia)" when describing the use of straight lines in the location of new detail on an existing map. The chapter that deals with this, Chapter X, is rather a novelty for any "popular" book on map reading, and is no doubt caused by the author's long association with the Ordnance Survey and its somewhat individual methods of graphic revision of the 1/2,500 map. Chapter XI on "Locating a Point" is as lucid a description of grid systems of reference as one could desire. It seems, however a pity to dismiss the claims of a system of reference based upon latitude and longitude (the Graticule) in an opening paragraph of twelve lines. It is true that India may have abandoned her Graticule minute mesh system of reference, but all the same the Graticule still remains the only system of reference of entirely world-wide application. Sheet lines are dealt with in a most interesting fashion in Chapter XII, and for the first time probably in any book a really clear and simple description of the well-known "Ansell" fold is given. So simple indeed is it that a sheet of foolscap can at once be laid upon the table and the system found to work at its first trial!

'A Key to Maps' has an excellent index and an attractive outer cover which has presumably been taken from the 2-inch drawings which were the basis of that masterpiece of cartography, the 1-inch-to-1-mile Ordnance Survey,

5th Edition. As far as can be discovered the book has but one misprint, that of "title" for "tithe" on p. 3. Messrs. Blackie are to be congratulated on this most welcome addition to their "Key" series. There is everything to praise and little to criticize in it and one can finish the book with a smile of pleasure and the author's very own last sentence itself "and great fun it all is." P. K. B.

ECONOMIC AND HISTORICAL GEOGRAPHY

AN APOSTLE OF EMPIRE: being the Life of Sir Lloyd William Mathews. By ROBERT NUNEZ LYNE. *London: George Allen and Unwin*, 1936. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 248 *pages; illustrations and sketch-maps.* 10*s* 6*d*

This little book may safely be commended to all who take an interest either in the rapid rise of East Africa from a state of savagery to one of comparative civilization, or a pride in the part the British played in the drama. Mathews was born in Funchal in 1850 and died in Zanzibar in 1901, a period covering the campaign for the abolition of the slave trade from the date of Sir Bartle Frere's mission in 1873 to its practical accomplishment in 1900. Of the figures given, but one need be quoted: the author estimates that between 1807 and 1895 "25,000,000 people of Central Africa lost their lives in consequence of the slave trade through the East African Coast ports." The book pivots upon this subject, and the story of emancipation.

At the present time those chapters (VII, VIII, IX, and XI) describing the doings of the "German Colonization Society," may be read with profit by all to whom such names as Sir John Kirk, Seyyid Bargash, and Mathews, who was then Brigadier-General in the service of the Sultan, represent nebulous personalities of the past. From about this time, 1886, the break-up of the Sultan's dominions on the mainland begins, and the story occupies much of the remainder of the book. Mr. Lyne is well qualified by personal experience and wide knowledge to describe his hero's life, a life full of self-sacrifice, inspired by the strictest sense of duty, and ended by malaria at the early age of fifty-one.

Zanzibar is the centre of the scenes amongst which the narrative moves, and a short chapter by J. T. Last on the island, consisting of extracts from a report sent to Sir Lloyd in 1899, forms an Appendix, although rather of a historical than practical interest at the present time. There is also a brief note on Latham Island, now part of the Zanzibar Protectorate. It is 350 yards long by 180 broad, surrounded by coral, and owes its name to its discovery by the East Indiaman *Latham* in 1758. A Chronological Table and a map of Zanzibar complete the volume. J. P.

AN HISTORICAL GEOGRAPHY OF ENGLAND BEFORE A.D. 1800. Fourteen studies, edited by H. C. DARBY. *Cambridge: University Press*, 1936. $9\frac{1}{2} \times 6$ *inches;* xii + 566 *pages; maps.* 25*s*

In recent years students of geography have come to recognize the importance of the time factor in their studies, and have thus been led to examine more closely the evolution through the centuries of those phenomena and distributions with which they are concerned. The present large volume of essays is an attempt to determine the human geography of England at several important epochs prior to the full development of the Industrial Revolution. The question whether this type of study has a just, or the sole, claim to the title of historical geography is left unanswered by the editor in his modest introduction, but he implies a contrast between this conception of historical geography and those which have been adopted by other writers, for example, the history of changing political boundaries, or the influence of geographical factors on historical events. Taking a broad view of the subject, this implied contrast is inexact. He and his colleagues

are primarily interested in what is now widely termed human geography, that is the distribution of particular manifestations of social life, settlements, agricultural systems, industries, and communications. But "changing political boundaries" surely derive their main significance from their relations to these distributions. If the point of view is confined to Southern Britain, this significance, for historical reasons, is not so pronounced as it would be for example in a study of Central Europe, though the Welsh marches and the Scottish border might be so treated. Regions of the type dealt with in these essays combine to form major natural regions, identical in varying degrees with the political organizations or nation-states, the relations of which are capable of being treated in precisely the spirit which has inspired this work. As regards the second implied contrast, if, to avoid the rather controversial term "influence," a phrase such as "the relation of geographical factors to historical events" may be substituted, surely this phrase is the whole theme of this work. These remarks are advanced here without the least intention of deprecating its value, or of suggesting that a philosophical introduction was necessary, but merely as a plea, at a time of reviving interest in historical geography, against too narrow a definition of that subject.

As has already been implied, knowledge of the geographical setting in appreciating historical events has long been recognized as essential, but the editor is justified in his claim that no work on this scale and with this particular emphasis has previously been devoted to England. Throughout the period the dominant factor is the permanence of the physical environment. In the first few centuries of historical times a certain degree of coastal submergence was in progress, and marine erosion and deposition have continued throughout, but the effects of these changes were of local importance only. The contributors are also agreed that within the same period the climate has not altered appreciably. It is evident therefore that the changes which the countryside has undergone have been the work of man, and thus reflect his social and technical organization. England was predominantly an agricultural country until the beginning of the nineteenth century, consequently the important elements of the "cadre naturel," apart from the general physical structure, were the distribution and qualities of the soils and the character of the original vegetation cover. The first necessity therefore is to establish this background. This has been done here as far as present knowledge permits by Dr. Wooldridge in his essay on the Anglo-Saxon settlement, in explanation of which he first establishes a classification of the physical regions of England on a basis of soil characteristics. The book would perhaps have gained had such a study formed an introduction to the whole, in addition to saving a certain amount of repetition in later chapters. The relation of the Saxon invasions and settlement to these regions is clearly demonstrated, and the writer shows how this evidence supports the archaeological argument for a line of advance along the Icknield Way to the upper Thames region. One point suggests itself here: namely the fate of the Roman-British population. It seems extremely unlikely that it was completely destroyed or driven out; if it was not, what relation did the Saxon settlements bear to the earlier? This chapter, with Mr. Gilbert's on Roman England, forms a valuable commentary upon the two historical maps published by the Ordnance Survey.

The natural environment having thus been established, each writer has had to interpret various types of historical material in relation to it, from the flints of Palaeolithic age, the distribution of Scandinavian place-names, and the record hidden in Domesday Book, to the increasingly voluminous documentary material of the later centuries. Each type of evidence presents its own problems,

and these are adequately handled by the various contributors, who have drawn, as is made plain on every page, from the scattered publications of their predecessors and colleagues. Indeed from the bibliographical point of view alone this book will be a necessity to future students in this field.

Two influences have been critical in the evolution of the English countryside: the introduction of the open-field system of agriculture and its supersession by compact holdings as a result of the enclosure movement. The nature and significance of the first is dealt with by Dr. Darby, though he does not make it altogether clear whether he regards the system as having been introduced in the Anglo-Saxon period or as being of greater age. The second movement has not received such comprehensive treatment, being discussed in various chapters. It would be of interest to know for example what effect if any enclosure had upon the distribution of settlement.

The later chapters are mainly concerned with the growth of industry and trade. There are interesting analyses of the geographical basis of foreign trade, and a very clear sketch of the growth of London between 1660 and 1800, which brings out the specialization of the various quarters. In the seventeenth and eighteenth centuries publicists were conscious of the importance of economic and social problems, and their writings, as is well shown here, provide a valuable source of material for the student.

It could not be expected that even so substantial a work as this could cover all England in equal detail. As the editor points out, much work on these lines remains to be done. This book however does establish securely the general framework, leaving to future students the filling in of the detail. Its main value should be in stimulating local researchers, and in ensuring that their work is based on sound principles.

Two points about cartographical history call for some comment. It is implied (p. 83) that Ptolemy's work consisted originally of tables of latitude and longitude alone. It is difficult to see how all these could have been derived by actual observation; the great majority were probably taken from maps of some kind. With regard to the reference (p. 528) to Chubb's 'Printed Maps in the Atlases of Great Britain and Ireland,' it should be noted that this does not list the many eighteenth-century county and regional maps published separately, as should be plain from the title of the work. Attention has already been drawn to the value of the bibliographical references: the numerous sketch-maps are also noteworthy, as indeed is the care which has been given to the editing and production of the whole book. All the contributions are written with a pleasant absence of dogmatism, or any leaning towards "geographical determinism." Students of history, if they are flattered by the recognition awarded to their subject by geographers, will also be grateful for this exposition of a distinctive approach to their problems. G. R. C.

THE ECONOMIST'S HANDBOOK: a Manual of Statistical Sources. By GERLOF VERWEY and D. C. RENOOIJ. *Amsterdam: The Economist's Handbook* [*London: Simpkin Marshall*], 1934. 10×6½ *inches;* viii+460 *pages.* [35*s*]

This reference work is organized in two main sections. The first is a subject classification of the sources for statistical information concerning the six chief industrial countries of Europe, and the United States. The second section sets out by countries all the sources previously mentioned, with the names of the responsible authority and the publisher, and supplementary publications of a more specialized character. Ease of reference is increased by additional indexes. The works listed include government returns, statements issued by financial and industrial bodies, the publications of economic information services, and

independent journals and newspapers. In the introduction a tribute is paid to the statistical work of the League of Nations and its constituent bodies. Recent developments however have checked the trend towards internationalization of information, and restricted the volume of details published. It is therefore the more necessary now to facilitate the proper use of existing sources, and to this aim the Handbook should contribute materially. G. R. C.

THE STATESMAN'S YEAR-BOOK. Statistical and Historical Annual of the States of the World for the year 1936. (Seventy-third Annual Publication.) Edited by M. EPSTEIN. *London: Macmillan & Co.*, 1936. 7×4½ *inches;* xxxiv + 1494 *pages.* 20*s*

The seventy-third issue of the Statesman's Year-Book has been brought up to date and follows the familiar lines of its predecessors as a compilation of political, social, and economic information about every country in the world.

The Introductory Tables furnish a number of important world statistics; concise information relating to the League of Nations is also given (pp. xxii-xxvii); and an index is provided. The remainder of the Year-Book is divided into three parts. Part I (pp. 1–454) deals with the British Empire and is preceded by three maps which show the two new Indian Provinces of Sind and Orissa, as well as the old Province of Burma, which is to be detached from India. Part II, in the following 200 pages, treats of the United States; Part III handles the remaining countries. The Table of Contents is clear and comprehensive, and an exhaustive index is given at the end of the volume. There is moreover an excellent bibliography for every state mentioned.

The Year-Book is a valuable and indispensable work of reference. It goes far beyond a mere collection of statistical tables and facts; moreover every page of this interesting volume bears the stamp of authority. E. C. W.

AS PORTAS DA INDIA EM 1484. By A. FONTOURA DA COSTA. *Lisboa: Imprensa da Armada*, 1935. 9×6 *inches;* 124 *pages; illustrations and maps*

In the search for new facts in old records there seems to be a special attraction in the possibility of pushing back the earliest happenings of any kind to a remoter date than that generally accepted. If for instance it could be shown that the Cape of Good Hope had been passed in an earlier Portuguese voyage than that of Dias, there is no question of the general interest that would be aroused. Such an attempt was made in 1933 at the Historical Congress at Warsaw by Professor E. Deprez, who called attention to a passage in a booklet printed at Rome, it seems, in 1485, which in his view made it probable that the Cape had already been passed by that date. The booklet contains the "Oração de Obediencia" pronounced in Rome in that year by the Portuguese Ambassador, Vasco F. de Lucena, and the passage in question might be thought to imply that the way to India had already been opened by Portuguese enterprise.

This has led the author of the present brochure, a leading Portuguese authority on such matters, to re-examine the records of Portuguese voyages in the last decades of the fifteenth century, and he has performed his task with minute care and full knowledge of all the relevant literature. The study to some extent goes over the same ground as the article by Dr. Ravenstein in this *Journal* for December 1900—itself based in part on Portuguese researches—which is quoted with general approval, a few only of Dr. Ravenstein's identifications of places touched at being questioned. After carefully examining each of the recorded voyages in the light of all available records, the author considers whether Professor Deprez's conclusion that a now unknown voyage, earlier than Dias's, had been the basis of Lucena's claim, is really necessary. He finds that it is not, for the first voyage of Cão in 1482–84, as understood at the time,

might well have encouraged a belief that the Gate of the Indian Ocean had then been reached. This is supported by the map of Soligo (1486) now in the British Museum, on which Cão's discoveries are recorded. Actually the turning point was just to the east of a cape in lat. 13° 26′ S., which corresponds closely with the latitude of Ptolemy's Cape Prasum, taken to be the starting-point for the last stage of the voyage to India; and as Cão had seen the coast trending east it was a natural idea that an open ocean lay in that direction. We may certainly agree that this simple explanation makes it unnecessary to accept Professor Deprez's more startling conclusion.

The study is thoroughly well documented, and provided with maps and illustrations so that it forms a useful summary of our knowledge of the subject. A valuable series of documents is printed at the end, including a facsimile reproduction of the first edition of Lucena's 'Oração.' E. H.

ROMAN ROADS IN SOUTH-EAST BRITAIN. By G. M. HUGHES. With notes by I. D. MARGARY. *London: George Allen and Unwin*, 1936. 7½×5 *inches; 232 pages; map.* 7*s* 6*d*

In forming an opinion about this book we must bear in mind that it is nearly fifty years since it was written, and it would be surprising therefore if its outlook was in all respects up to date. Some sections, too, with which the author was probably less personally acquainted, are very lightly dealt with, and it may well be that had he lived to complete the work he would have made considerable additions before publication. These imperfections may be the more readily forgotten when the author's pleasant easy style of writing is enjoyed. Moreover he has given us some original observations and suggestions which, despite all the work that has since been done, may still be of real value to field workers. Among these may be mentioned the suggestion that the Antonine Itineraries were measured from military station to station, not to the civilian town centres; suggested identification of the positions of Vagniacae, Durolevum, and Vindomum, based upon the Antonine distances; and observations upon unrecorded Roman roads between Staines and Winchester and elsewhere. A clearly-drawn map on a good scale is given, evidently based upon the O.S. Roman Britain map, but it is sadly spoiled by careless mis-spellings, *e.g.* Calleoae for Calleva, Poplem for Popham, etc., and it must be rare nowadays to find a competent draughtsman content to show Dorking and Leatherhead north of Godstone. It is regrettable that a good publishing house should be satisfied to show such glaring errors on a map essential to a topographical book issued by them. I. D. M.

THE ORIGINAL WRITINGS AND CORRESPONDENCE OF THE Two Richard Hakluyts. Edited by E. G. R. TAYLOR. (Works issued by the Hakluyt Society. Second Series. Nos. LXXVI and LXXVII. Issued for 1935.) *London*, 1935. 9×5½ *inches*. Vol. I, xiv+210 *pages*. Vol. II, x+211–516 *pages. illustrations and facsimile maps*

In his essay on 'England's Forgotten Worthies,' J. A. Froude attacked the Hakluyt Society for producing volumes which "have left little undone to paralyse whatever interest was reviving in Hakluyt." The criticism was perhaps unfair, yet the fact remains that the Society has waited for nearly a hundred years before giving its members a work dealing primarily with the writer of "the Prose Epic of the modern English Nation," though it has faithfully and successfully fulfilled its main object of editing and printing 'Records of Voyages, Travels and Naval Expeditions and other geographical material,' including the 'Divers Voyages' and the 'Principal Navigations' of the younger Hakluyt. It was a happy suggestion of Professor E. G. R. Taylor that the miscellaneous writings of Richard Hakluyt the Lawyer and Richard Hakluyt the Preacher should be collected and pub-

lished by the Society. The presence of the younger man's 'Discourse of Western Planting' in these volumes is alone enough to justify them, but there is much else among the 137 documents and extracts that is of permanent value. No student of either the history of geography in England or the colonial expansion of the country in the sixteenth and seventeenth centuries can afford to neglect the material which they contain. In her introduction Professor Taylor brings out the importance of the documents and makes it easy to put them in their proper setting. She is to be congratulated on another scholarly work which has been produced with all the care and taste characteristic of the volumes of the Hakluyt Society. J. N. L. B.

THE JOURNAL OF JAMES MORRISON, BOATSWAIN'S MATE OF The *Bounty*, describing the Mutiny and subsequent misfortunes of the Mutineers, together with an account of the Island of Tahiti. Edited by OWEN RUTTER. *London: The Golden Cockerel Press*, 1935. 12½×7½ *inches; 242 pages; illustrations* (by ROBERT GIBBINGS). £3 3*s*

The *Journal* of James Morrison, boatswain's mate of the *Bounty*, is in the Mitchell Library, Sydney. Its existence has been known for some time, but it was a happy accident which led Mr. Rutter to discover its present home. Mr. Rutter has already contributed to the growing body of literature on the mutiny of the *Bounty*. He has now edited this journal, which "is the only original source of information as to the activities of the mutineers after they had cast Bligh adrift," and which has never previously been published although it has been used by earlier writers. It is thus of great importance as giving the other side of the story which Bligh has told in his *Narrative*. In addition to the *Journal*, Morrison wrote a long and detailed account of the island of Tahiti, occupying half of the present volume. He was an observant man, and little escaped his notice, so that his record is of permanent value. Mr. Rutter has added a short introduction and a few notes, but there is neither map nor index. J. N. L. B.

GENERAL

SAIL: the Romance of the Clipper Ships. Volume III. Pictured by the late J. SPURLING. Storied by BASIL LUBBOCK. Edited by ALEXANDER CAMPBELL. *London: Blue Peter Publications*, 1936. 12½×10 *inches;* viii+102 *pages; illustrations and map*. 30*s*

This volume completes the well-known series of paintings of the clipper ships by the late Mr. J. Spurling, the first two volumes of which were noticed in this *Journal* for January 1928 and February 1930. Mr. Spurling in his younger days had served seven years at sea, and even at that time had begun to paint, a career which he continued later to combine successfully with that of an actor. The period mainly dealt with in this volume is that of the last struggle between the iron sailing ship and the steamer, in the early 'eighties of the last century, when the trade boom encouraged owners to invest their money in these vessels. The boom however did not last long, and most had passed out of British ownership by the first decade of the twentieth century. Apart from the details of construction, rigging, and performances, the notes accompanying each picture contain many interesting incidents of sea life at a turning point in the history of the mercantile marine. It is perhaps natural that the writer should be to some extent a lauder of past times, and an upholder of the virtues of a training in sail. The reader of these pages will also gain a good deal of knowledge of "practical" geography. At a time when a truer appreciation of the importance of the merchant navy is necessary, the publishers have done well to complete this valuable record. G. R. C.

THE MONTHLY RECORD

THE HUDDERSFIELD WOOLLEN INDUSTRY

We have received from the Tolson Memorial Museum, Huddersfield, a handbook entitled the 'History of the Huddersfield Woollen Industry,' by Mr. W. B. Crump and Mrs. G. Ghorbal. This monograph, though issued in connection with the exhibits in the Museum, provides in itself a detailed and interesting account of the development of the industry from the fourteenth century to the Great Exhibition of 1851, which explains how Huddersfield has come to be the centre of its region, and why the woollen industry has remained supreme there. The writers emphasize its early beginnings and continuous development, and the enterprise with which each advance in technique was turned to account locally. A clear account is given of the several processes involved in the transformation of the wool into cloth. Wool from the native moorland sheep and the presence of plentiful streams of soft water were the elements of a domestic industry for a considerable period when the rough cloth was held of little account by the merchants of York. Until the eighteenth century the domestic character of the industry was preserved. The presence of local supplies of coal and iron, accessible, if not in considerable quantities, favoured the growth of subsidiary trades. The dispersed character of the industry is partially explained in Defoe's well-known reference to "coals and running water upon the tops of the highest hills." With the developments of the eighteenth century, this distribution of population underwent a change; the fulling mills developed into scribbling mills requiring swift-running streams for their power, which resulted in a concentration of activities in the valley bottoms, a concentration further enforced by the development of communications, so that a stratification of industry resulted, "a horizontal cleavage between the weaving or manufacturing on the hills, and the carding and spinning in the valleys." The final process in the development came with the building of mills by the clothiers, and the introduction of power looms, when weaving could survive in the hill-top towns only if coal was available locally or obtainable economically.

During the sixteenth and seventeenth centuries the local market for the cloth was at Almondbury, where the weekly market dated from 1294. The grant for a market at Huddersfield was not obtained until 1671, but a large proportion of the output probably went to London and elsewhere. The pre-eminence of Huddersfield was finally established by the building of the Cloth Hall in 1766, and an interesting account is given of the method of conducting business therein, and of the part it played in the organization of the industry.

The handbook contains a number of interesting illustrations, particularly of the characteristic mullioned windowed houses of the weavers.

The geographical setting of the industry in the whole area is described by Mr. W. B. Crump in an article on "The wool-textile industry of the Pennines in its physical setting" in a paper reprinted from the *Journal* of the Textile Institute, vol. 36, 1935. He emphasizes the lower and more dissected character of the southern Pennine plateau, the relatively large proportion of the region lying between 500 and 1000 feet—the favourite zone of early settlement—the core formed by Millstone Grits with a fringe of Lower Coal Measures, and the absence of limestones resulting in soft water suitable for textile trades. All the established textile market towns lay on the edge of the coalfields, and were thus able to adopt steam power without much dislocation. These physical features in association with high rainfall and low mean temperature have contributed to the economic development of the region.

EARLY MS. MAP OF THE COUNTY OF DURHAM

Mr. Gordon Manley in an article entitled "The earliest extant map of the County of Durham" (printed in the *Transactions* of the Architectural and Archaeological Society of Durham and Northumberland, 7, 1936) discusses a manuscript map of the county in the well-known 'Burleigh Atlas' of the British Museum. The body of the Atlas is composed of the printed maps of the English counties published by Saxton in 1579. The manuscript map in question, one of several, bears no date or author's name. Its size, 21 by 15 inches, approximates closely to that of Saxton's maps, to which, also, its general style bears some resemblance. Mr. Manley concludes that it is an independent piece of work, somewhat hastily executed, with no obvious relationship to earlier published maps. The trend of the coast is quite accurately represented, and the rivers in the eastern portion are in good relation to each other, but away from the centre of the county distances and bearings show serious errors. It is suggested that a map of this type might have been compiled by an intelligent man, for example, Sir George Bowes, whose business entailed a considerable amount of riding through the county.

A certain number of corrections and additions have been added in Lord Burleigh's hand. Most of these names are of important landowners, near the route by which help from overseas might have been sent to the rebels of 1569. As these names are those of the holders prior to the redistribution of land following upon the rebellion, in which Burleigh naturally took a keen interest, the writer is justified in seeing a close relation between this map and the events of 1569. The evidence of the watermark also supports this conclusion. The paper was made at Troyes and occurs throughout Western Europe, for example, at Amsterdam between 1566 and 1583. It is also found in paper used in the Bowes MSS. dated 1570. The latter fact suggests, also, a connection with the Bowes family. It may be assumed therefore that this map antedates Saxton's by several years, and that rough maps of various areas existed before his more exact surveys.

DR. FILCHNER'S JOURNEY IN NORTHERN TIBET

The Secretary has received a letter from Dr. Wilhelm Filchner, dated Tangkar, Kansu, April 4, which contains the first information given to the Society of his new expedition in North-Eastern Tibet. His first object was to reach Eastern Tsaidam, after which his plans were indefinite. On the journey he proposed to carry out astronomical, magnetic, and trigonometrical observations, to provide a framework for a possible later survey of the area from the air. His heavy baggage was to start the following day, and he proposed to leave a few days later.

A message published in the press at the end of July stated that Dr. Filchner, travelling north of Koko-Nor, had reached Golmo in the Tsaidam region, despite difficulties with his caravan. He had arranged with the local authorities for guides and was preparing for the next stage to Teijinar, west of Tsaidam. He anticipated spending the winter in the country north of the Tien Shan.

THE COURSE OF THE WADI DRA'A

The conspicuous right-angled bend in the course of the Wadi Dra'a suggests that the upper course of the Wadi has been captured by one flowing to the Atlantic, and that the Dra'a at one time drained, in common with the Saoura, Niger, and Tamanghasset, to an inland sea north-west of Timbuktu. Though he does not claim to have proved this definitely, Captain Pigeot records in the *Revue de Géographie physique* (vol. 7, 1935, fasc. 2) additional facts recently gathered which strengthen this theory. After flowing in a north-west–south-

east direction across the Bani, the Dra'a debouches upon the Sahara and turns westwards, traversing the Bani again, 500 km. farther down, to reach the sea. The lower course of the Daoura, to the east, is characterized by great deposits of alluvium, which created lakes on its right bank, now represented by *sebkhas*. Between the Daoura and the Dra'a is an area, consisting of a number of small basins of interior drainage, which drain to neither of these wadis. Until recently it was thought that all these basins were closed on the south by a sharp cliff forming the edge of the Hammada of the Dra'a. Reconnaissances in the summer of 1933 revealed a vast depression extending north-westwards from the Murezhelin *sebkha*, near the Daoura, to the edge of the Dra'a plateau. A later reconnaissance showed that the north-western side of this depression is breached, and it is through this breach that Captain Pigeot supposes the former course of the Dra'a to have lain.

Confirmation is also to be obtained from the character of the present course of the Dra'a. About 200 km. west of the suggested point of capture a wide valley runs in from the north: seen from the air above this point the Dra'a seems to disappear for the time, being hidden in a narrow gorge disproportionate to its size. Some distance above this point the Dra'a winds in broad meanders, recalling the lower Daoura. The writer suggests that with the silting up first of the Daoura, and then of the Dra'a, the waters of the latter formed a large lake in a right-bank tributary, the capture taking place either by an overflow into the present lower course, or by headward erosion of a tributary.

JOURNEY IN CENTRAL AUSTRALIA

A brief report of what is claimed to be the first crossing of the Simpson Desert, Central Australia, by Mr. E. A. Colson was published in *The Times* of August 19. Mr. Colson travelled by camel eastwards from a point on the Finke river about 100 miles north of Oodnadatta to Birdville in Queensland, a distance of about 300 miles accomplished in sixteen days. The early portion of the route lay over loose, sand-crested hills, alternating with limestone flats, in places well vegetated. For the next 100 miles there was a fair amount of desert shrubs, the mulga being dead but showing signs of new growth. On the seventh day he reached the first dry salt lake, about 5 miles in length, and from this to the end of his journey passed ten more dry lakes, varying from a half to one and a half miles in width. He reports that the area is by no means desolate, containing much grass and shrubs, with few harmful plants. It had recently emerged from a very severe drought, but the rains had already had a marked effect. He believes that water from wells or bore will be obtainable in this area, and that then the introduction of herds and flocks will improve the pasturage. Recurring droughts however make it improbable that it can be settled at present. He found no evidence for the suggestion that the sands are moving southwards and devastating the districts to the south and west. There were no signs of their encroachment on the lakes to the east, or on timber.

THE CYCLONE AT LOW ISLES

The island reef which was the headquarters of the Great Barrier Reef Expedition (1928–29) was visited by a tropical storm in March 1934. In a recent report of the Great Barrier Reef Committee (vol. IV, part 2, Brisbane, 1935) Mr. Moorhouse, who was an Australian member of the expedition and is now permanently associated with the committee, gives an account of the storm and its effects on the reef. At the end of the rainy season, on March 12th, early in the morning the first unusual signs appeared. High water was at 6 a.m., but it was noted that the tide was much higher than usual for March and that the ebb was slow in beginning. At 8 a.m. the first rain squalls began from the south-east

and were almost at once strong enough to damage trees and lift loose objects. The barometer fell to 29·00 ins. by 9 a.m. and soon after the wind veered into the east, but blew unabated, so that the tide was actually 4 feet higher than at 6 a.m. and 6 feet above the expected height at high water. Rain ceased at 11.30 a.m. and improvement set in soon after.

The damage and effects are shown on a modification of Mr. Michael Spender's map published in the *Journal* for September 1930. Considering that the wind never blew out of the "undefended" north-western semi-circle (the prevailing wind is at south-east) it is remarkable how disastrous the storm was for the living coral on the reef flat. Much of this had been overwhelmed by the advance of shingle ramparts. Many of the clams (Hippopus) had been washed on to the reef flat, there to die. The damage to the mangrove trees was also considerable. Large boulders had been washed up on the north-east beach, a fact that recalls the expedition's explanation of their occurrence to just such a cause. The sand of the cay had been removed at the eastern face and redeposited at the western end. High-water mark now lies amongst the foundations of some of the Expedition huts.

JOURNEY IN SOUTHERN BAFFIN LAND

Mr. J. Dewey Soper gives a summary account of his exploration in 1930–31 of a portion of southern Baffin Land in the *Geographical Review* for July. His base was established at Lake Harbour, a Royal Canadian Mounted Police post, in July 1930. After determining the astronomical position, he completed a triangulation system to serve as a control for his future work, and during his stay carried out 155 hourly readings to obtain values for the magnetic declination. In the autumn he accomplished a considerable amount of survey work along the coast. The spring and summer were spent in surveying the lower half of the river known to the Eskimo as the Koukdjuak, but which, to avoid confusion with the river of the same name draining Nettilling, the Geographic Board of Canada has named the Soper River.

Lake Harbour is the best harbour in the region, lying 11 miles from the open sea, with sufficient depth for any ships now navigating the Arctic. Twelve miles to the north, the southern wall of the interior mountain range, roughly parallel to the coast, rises to 1200–1500 feet. The area appears to lack economic minerals, though some mica is being mined locally. The valleys have a poor covering of plants, but inland this becomes markedly more luxuriant. Small rivers and streams, fed by the gradual thawing of the mountain slopes, are abundant, the larger ones having a maximum length of about 60 miles. A number of small lakes are found in the Pre-Cambrian areas, and in addition to the two well-known lakes, Nettilling and Amadjuak, Eskimo report two other large lakes in the southern portion of Baffin Land.

The Soper River is the largest known to discharge into Hudson Strait. Near its mouth it is broken by rapids, with a fall of 20 feet in three-tenths of a mile. North of 63° 04′ rapids again occur very frequently, and this portion of the course is impressive, the average width of the valley being one-half to three-quarters of a mile, with the mountain wall rising on both sides to 1500 feet. Above this point the river receives four tributaries, all unnavigable, that from the east descending about 560 feet in 3½ miles. The northern portion of the valley as far as the limit of the survey is characterized by the development of gravel beaches on both banks, from 10 to 50 feet above stream-level: a higher series ascends to at least 110 feet. It is said that away from the rivers and their precipitous tributaries, sledging on the plateau is not difficult. The river is stated by Eskimo to rise in many small streams about 70 miles north of Lake Harbour. It is navigable for about 35 miles from Lake Harbour.

THE NORTHERN FACE OF MOUNT EVEREST

based on Photogrammetric Surveys by Michael Spender

Scale 1/20 000

Yards

200 0 200 400 600 800 1000 1200

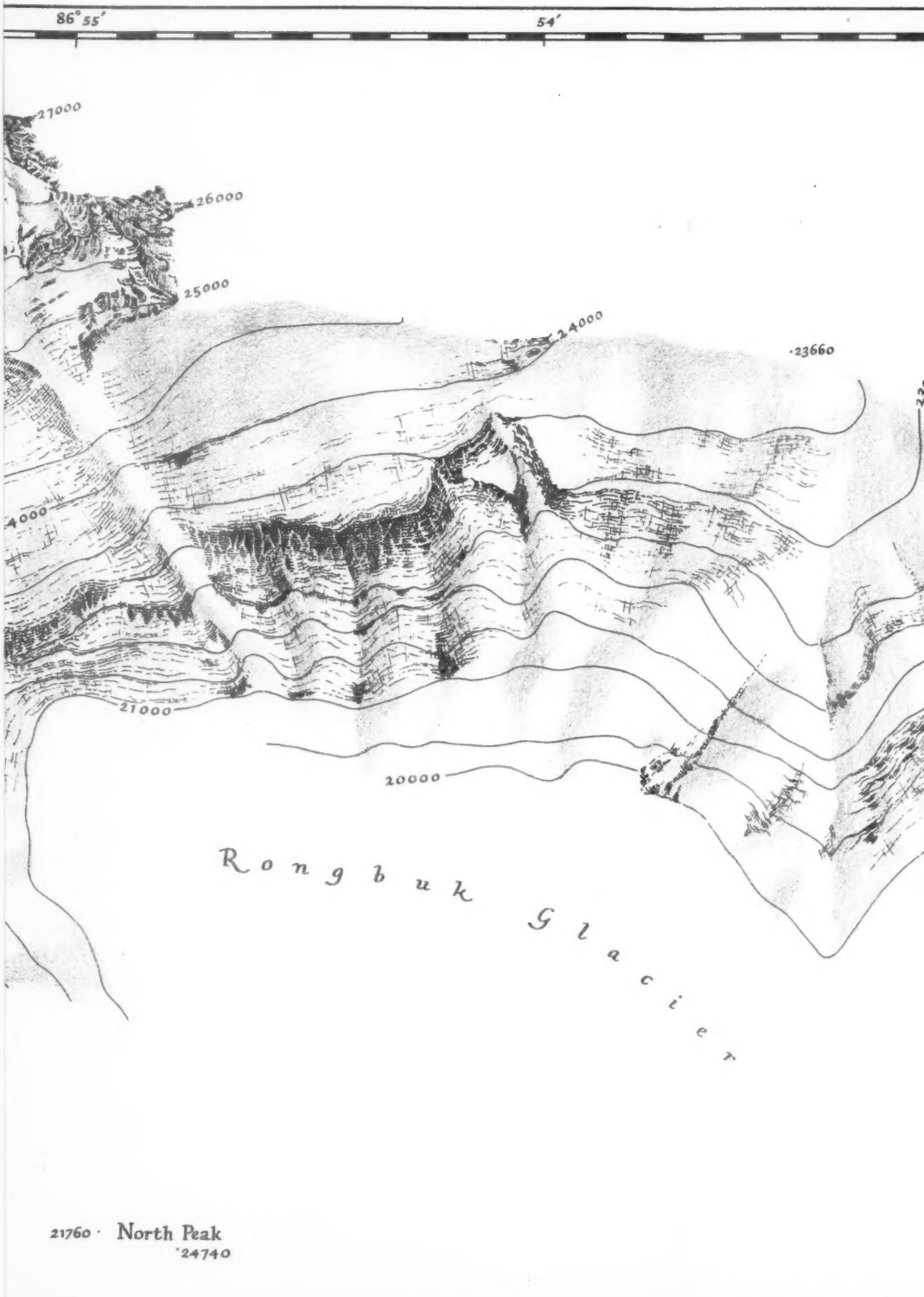
Metres

200 0 200 400 600 800 1000 1200

Heights in feet and approximate contours by stereo-photogrammetry.

H.E. Milne, del.

Published by the Royal Geographical Society



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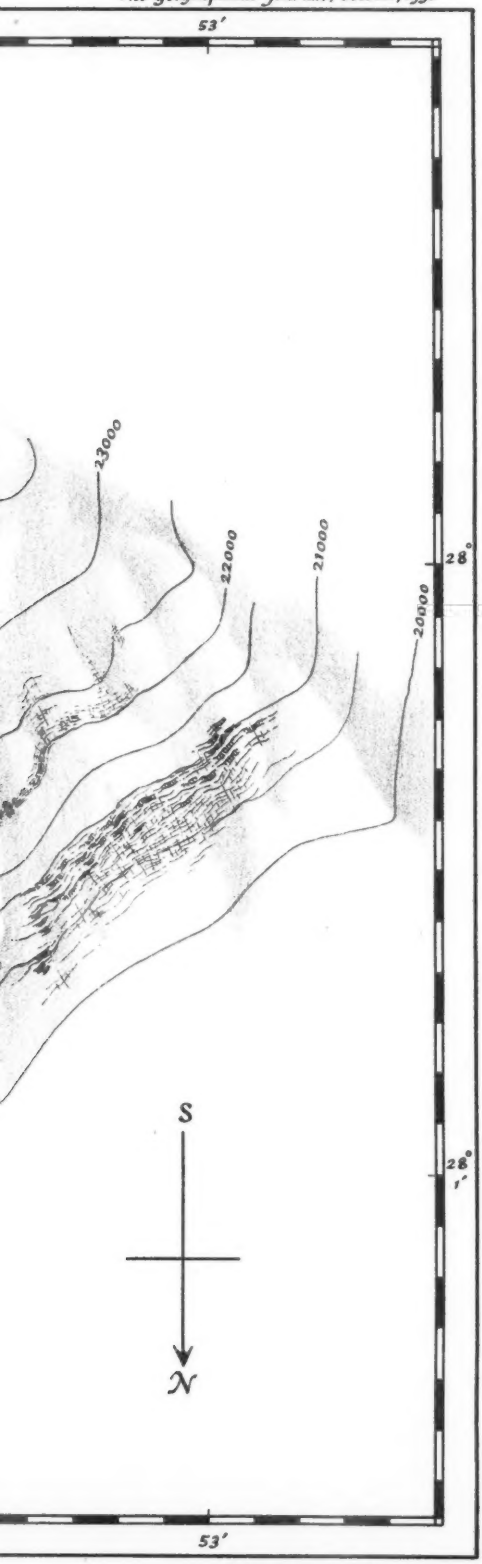

MOUNT EVEREST
Spender